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REMARKS

This application includes pending claims 9, 12-18, and 21-26. Claims 9 and 18 are currently amended and claims 10, 11, 19, and 20 are cancelled. Reexamination and reconsideration of the application are requested.

This response is supported by the Cigallio and Dougherty Declarations, which are cited below as evidence and were previously submitted in response to the last office action. Both Mr. Cigallio and Mr. Dougherty are named inventors in this application and experts in the field of printed flexible packaging technology. Cigallio Declaration, ¶ 1, and Dougherty Declaration, ¶ 1. Copies of the Declarations are not submitted herewith as they should be present in the Office file.

Abstract

The disclosure is objected to because of informality in the Abstract. The Abstract has been amended to replace "heat to technology" to --heat tube technology--. Applicant respectfully submits the objection to the specification is overcome.

Drawings

The drawings are objected to under 37 C.F.R. §1.83(a). The Examiner takes the position that the drawings must, but do not show the "forming a portion control size package" and "feeding the portion control size package" features recited in the independent claim of the application. This objection is respectfully traversed.

37 C.F.R. §1.81 requires that an Applicant for a patent furnish a drawing of his or her invention where necessary for the understanding of the matter sought to be patented. Applicant respectfully submits that further illustrations of embodiments of the invention are not required for one of ordinary skill in the art to understand this invention. Systems for making portion control size packaging using a form/fill/seal system have been well known to those of ordinary skill in the art for decades. The present application includes a schematic diagram in Fig. 3

illustrating a film feeder 54 that feeds heat sealable laminate to a form/fill/seal unit 52, a flowable material feeder 56 that delivers flowable material for the packaging to a form/fill/seal unit. These features are illustrated in the form of labeled boxes in the schematic. According to 37 C.F.R. §1.83, this is proper when illustrating conventional features disclosed in the description and claims of an application. In particular, 37 C.F.R. §1.83 provides that "conventional features disclosed in the description and claims, where their detailed illustration is not essential for a proper understanding of the invention, it should be illustrated in the drawing in the form of a graphical drawing symbol or a labeled representation (e.g., a labeled rectangular box)." Thus, Applicant respectfully requests that the objection to the drawing be withdrawn.

Written Description

Claims 9-26 of the application are rejected under 35 USC §112, lst ¶, as failing to comply with the written description requirement. The Examiner takes the position that the application does not explain how to achieve portion control packaging which is a claimed feature of the present invention. This rejection is respectfully traversed.

As explained hereinabove with regard to the objections of the drawings, manufacturing portion control size packaging with a form/fill/seal system has been well known to those of ordinary skill in the art for decades. Portion control size packaging is relatively recent terminology describing what was previously referred to in the art as single or individual serving packaging. Examples of portion control package products that have been around for decades are the one to one and a half ounce ketchup and mustard packs available at virtually all fast food restaurants. Flexible portion control packaging made with form/fill/seal systems were so well known at the time this invention was made, the Association For Dressings & Sauces had published in 1999 the portion control and flexible packaging reference manual for the dressings and sauces industry. A copy of this first edition is submitted herewith in its entirety to

demonstrate how well known was this technology at the time this invention was made. Applicant respectfully submits that further written description of well known form/fill/seal technology is unnecessary to convey to one skilled in the art that the inventors of the present application have possession of the claimed invention. Thus, Applicant respectfully submits that this rejection under 35 USC §112, lst ¶, be removed.

<u>Novelty</u>

Claims 9, 10, 12-19 and 21-26 are rejected under 35 USC §102(e) as being anticipated by U.S. Patent 6,301,859 issued to Nakamura et al. (the Nakamura Patent). The Examiner cites the Nakamura Patent as disclosing all features of independent claims 9 and 18 of the application. The Examiner specifically takes the position that the Nakamura Patent discloses a form/fill/seal apparatus for forming a portion control size package. This rejection, as applied to amended claims 9 and 18, is respectfully traversed.

Independent claim 9 of this application describes a system for making portion control sized packaged flowable liquid-containing condiments in a portion size in the range from 1 to 5 ounces comprising a form/fill/seal apparatus and a heat seal die that includes longitudinal <u>heat seal tubes</u> for substantially uniform heating of the die face of the heat seal die. Independent claim 18 describes a corresponding method for making portion control sized packaged flowable liquid-containing condiments in a portion size in the range from 1 to 5 ounces.

More particularly, the system of amended claim 9 describes a heat sealable material feeder, a flowable material feeder for feeding a flowable liquid-containing condiment, and a form/fill/seal apparatus structured and arranged for making portion control sized packages so that the portion control sized package has a portion size in the range from 1 to 5 ounces. Specifically, this form/fill/seal apparatus is structured and arranged for receiving the heat sealable material, forming a portion control sized package with the heat sealable material, filling the portion control

sized package with the flowable liquid-containing condiment in a portion size in the range from 1 to 5 ounces, and sealing the portion control sized package. The form/fill/seal apparatus includes a heat seal die comprising first and second heating elements and first and second longitudinal heat tubes disposed, respectively, in first and second die members. The heat tubes, which can also be described as heat pipes, are disposed between the heating element and the die face of each die member for maintaining a substantially uniform heat seal temperature along the length of the die faces. The substantial uniformity of heat seal die temperature significantly decreases the occurrence of serum leakers, which are packages that leak liquid through the package seal. Cigallio Declaration, ¶ 5.

Although the Nakamura Patent does disclose a form/fill/seal apparatus, it does not disclose a system or method for manufacturing what has become known as portion control size packaging. As described in the previously submitted Cigallio Declaration in ¶2, portion control size packaging is packaging that controls the amount of package product provided to the end user, such as in condiment packaging for use by fast food consumers. An enclosed excerpt from the website www.portionpac.com describes a portion pack as individually portioned packages of wet or dry condiments, sauces, dressings, jams, jellies, and toppings. As described in Applicant's specification, such products are typically packaged in single one to five ounce servings. The Nakamura Patent does not disclose or suggest portion control size packaging manufacture of condiments in a portion size in the range from 1 to 5 ounces. Because the Nakamura Patent does not disclose this feature of Applicant's independent claims, it does not anticipate them and Applicant respectfully requests that this rejection under 35 USC §102 be removed.

Non-obviousness

The Examiner rejects claims 11 and 20 and 18-26 under 35 USC §103(a) as being obvious over the Nakamura Patent. With regard to claims 11 and 20, the Examiner acknowledges that the Nakamura Patent does not expressly disclose manufacturing portion size products in the range of one to five ounces, but takes the position that the manufacture of such portion sized products would have involved only routine skill in the art. With regard to claims 18-26, the Examiner acknowledges that the Nakamura Patent may not disclose packaging a flowable liquid containing material, such as condiments, but takes the position that it is a well known practice in the art to package flowable liquid containing materials such as condiments in flexible packaging of thermoplastic film. This rejection is respectfully traversed.

Applicants' independent claims 9 and 18 now include the subject matter of claims 11 and 20, as well as claims 10 and 19.

Applicants respectfully submit that it would not have been obvious to one of ordinary skill in the art at the time this invention was made to make portion control sized packaged flowable liquid containing condiments with a form/fill/seal system incorporating a heat seal die comprising heat tubes. In summary, the independent claims of this application would not have been obvious because the Nakamura Patent does not disclose such portion control sized packaging manufacture and teaches away from using heat tubes to heat seal dies in form/fill/seal systems. A prior art reference that teaches away from the claimed invention is a significant factor to be considered in determining obviousness and does not establish a prima facie case of obviousness. M.P.E.P § 2145; M.P.E.P § 2143; *In re Fine*, 873 F.2d 1071, 5 USPQ 2d 1596 (Fed. Cir. 1988). Furthermore, Applicant has submitted substantial evidence of secondary considerations indicating nonobviousness of the subject matter in independent claims 1 and 18. According to the recent Office Action, the Examiner did not consider such evidence supporting

secondary considerations; when evidence is submitted, such secondary considerations must be considered by the Examiner. MPEP § 2144.08(B); *Graham v. John Deere,* 383 US1, 17, 86 Supreme Court 684, 694, 148 USPQ 459, 467 (1966); *Simmons Fastener Corp. v. Illinois Tool Works*, 739 F.2d 1573, 1575, 22 USPQ 744, 746 (Fed. Cir. 1984).

Applicants respectfully submit that the Nakamura Patent does not establish a prima facie case of obviousness under §103 because the Nakamura Patent expressly teaches away from using heat tubes in heat sealing dies (see col. 9, l. 44 – col. 10, l. 27) such that there is no motivation to modify the teaching of the reference to use heat tubes in the manufacture of portion control sized packaged condiments and there is no reasonable expectation of success in doing so. Furthermore, several secondary considerations such as failure to appreciate the problem to be solved, long felt but unsatisfied need despite availability of components, unexpected results, existence of licensees, and commercial success are evidence that the subject matter of the independent claims of this application describe patentable subject matter and such evidence must be considered.

The Problem To Be Solved

Form/fill/seal machines for making portion control sized packaged condiments simultaneously seal the bottoms, and then the tops of several packages, as many as 12 or more packages at once. In this circumstance, uniform temperature, pressure, and dwell time across the flexible packaging material are critical. When sealing flexible packaging material to make portion control sized packaging, the two opposing faces of the flexible material must be heated to at least a temperature at which the material softens, but not so high as to liquefy. The softened surfaces must be pressed together and maintained in intimate contact for a time sufficient to allow the entanglement of polymeric molecules across the interface separating the surfaces. As the sealed area cools, the entangled polymers effectively weld the two surfaces together,

eliminating the previously separate surfaces and becoming a monolithic layer of material with thickness approximately equal to the sum of respective thickness of each of the two materials. This combination of pressure, temperature, and time of pressure application (dwell time) constitute the three basic variables used to control heat sealing processes. Cigallio Declaration, ¶ 7.

In portion control packaging, narrow channel leaks can be formed when heat sealing flexible materials together to form the packages, particularly when the temperature along the length of the heat seal die is non-uniform such that the temperature in some areas falls below that required for adequate heat sealing. These narrow channel leaks can escape detection until after the portion control packages are packed and distributed in bags or cases. Channel leaks in portion control packaged condiments leak serum from the condiment inside the packages and can contaminate the entire contents of bags or cases of portion control sized packaged condiments. Cigallio Declaration, ¶ 8.

The Cited References

The Nakamura Patent teaches conventional form/fill/seal packaging and does not relate to what is known in the industry as portion control size packaging of condiments. The Nakamura Patent teaches using heat sealing jaws comprising heat conducting members 33a and 33b such as solid rods of copper having a high conductivity, instead of heat tubes or heat pipes as described in amended independent claims 9 and 18 of this application. Col. 8, l. 39-42. The heat seal jaws disclosed in the Nakamura Patent are not for portion control sized packaging as they are larger and include an integral cutter blade 30 and cutter groove 22 for simultaneously cutting flexible packaging upon heat sealing. The Nakamura Patent describes a concern with heat transfer through the depth of the heat seal dies from the heating element to the die face. The solution in

the Nakamura Patent is to place the high conductivity solid copper rods between the heating elements and the die face of the heat sealing jaws. Cigallio Declaration, ¶ 9.

The Nakamura Patent expressly teaches that heat tubes (heat pipes) should not be used in the heat sealing dies, taking the position that heat tubes do not distribute heat adequately in the radial direction. Col. 9, l. 44 - col.10, l.27. Figs. 11A and 11B of the Nakamura Patent illustrate a prior art heat seal die comprising heat tubes, but the specification of the Nakamura Patent teaches that heat tubes should not be used. Cigallio Declaration, ¶ 10.

No Prima Facie Obviousness

According to M.P.E.P. §2142, three basic criteria must be met to establish a *prima facie* case of obviousness. First, there must be some suggestion or modification, either in the references themselves or the knowledge generally available to one of ordinary skill in the art to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Third, the prior art reference (or references when combined) must teach or suggest all of the claim limitations. The teaching or suggestion to make the claim combination and the reasonable expectation of success must both be found in the prior art, and not based on Applicants' disclosure. *In re Vaeck*, 947 F.2d 488 20 U.S.P.Q. F.2d 1438 (Fed. Cir. 1991). Furthermore, prior art that teaches away from the claimed invention demonstrates a lack of *prima facie* obviousness. *In re Hedges*, 783 F.2d 1038, 228 USPQ 685 (Fed. Cir. 1986); *In re Fine*, 873 F.2d 1078, 5USPQ 2^{nd} 1596 (Fed. Cir. 1988).

None of the three basic criteria of *prima facie* obviousness are met here and applicants respectfully submit that the Nakamura Patent does not establish a *prima facie* case of obviousness against amended claim 9 and 18 of this application. First, there is no motivation to modify the Nakamura Patent to make portion control sized packaged condiments, because the Nakamura Patent actually teaches away from using heat tubes, does not suggest using heat tubes

in portion control sized packaging systems, and certainly does not appreciate the problems particular to the smaller, thinner portion control sized packaging heat seal dies. With portion control sized packaging heat seal dies, there is little concern about heat transfer through the depth of the dies, as they are small and thin. Instead, the concern is uniformity of temperature along the long length of the dies. This problem is well addressed by Applicants' invention as defined in independent claims 9 and 18 of this application, while the Nakamura Patent does not address portion control sized packaging systems or this problem, and even teaches away from using heat tubes. Cigallio Declaration, ¶ 12.

Furthermore, there would have been no reasonable expectation of success to one of ordinary skill in the art at the time the invention was made in view of the Nakamura Patent which clearly teaches not using heat tubes in heat seal dies. The Nakamura Patent describes heat tubes as inadequate in heat sealing. Perhaps that is true for the heat dies described in the Nakamura Patent, but Applicants' have shown that it is very effective in heat seal dies for portion control condiment form/fill/seal packaging systems. Cigallio Declaration, ¶ 13.

The technology of claims 9 and 18 encompasses a preferred embodiment wherein multi-lane portion control packaging machinery system makes many (equal to the number of lanes) pouches with each cycle of product delivery. This multi-lane, multi-pouch production cycle efficiently produces portion control condiments. The subject matter of claims 9 and 18 provides consistent seal integrity across multiple lanes of this machinery. In contrast, the Nakamura Patent teaches that heat tubes do not adequately maintain an acceptable longitudinal temperature variation (i.e. in the direction "X" as indicated in Figure 1A) for heat-seal jaws (Column 9; lines 44-67). In fact, multi-lane portion control packaging machinery has heat-seal jaws with much less depth (Dimension "Y" in Figure 1b) than the packaging machinery described in the Nakamura Patent. Cigallio Declaration, ¶ 16.

The criteria of prima facie obviousness are therefore not met by the Nakamura Patent. Accordingly, Applicant's respectfully submit that the rejection of Applicants' amended claims under the Nakamura patent be removed.

Secondary Considerations

A fourth factor that <u>must</u> be considered in evaluating nonobviousness is a number of "secondary considerations." *Graham v. John Deere,* 383 US1, 17, 86 Supreme Court 684, 694, 148 USPQ 459, 467 (1966); *Simmons Fastener Corp. v. Illinois Tool Works*, 739 F.2d 1573, 1575, 22 USPQ 744, 746 (Fed. Cir. 1984). Such secondary considerations include, but are not limited to, unexpectedness of the results of the claimed invention to those skilled in the art; a long felt but unsatisfied need for the claimed invention while the needed implementing arts and elements have long been available; commercial success of the invention causally related to the invention itself, rather than to companion factors such as advertising or attractive packaging; replacement in the industry of prior art devices by the patented invention; acquiescence by the industry to the patent's validity by taking licenses under the patent; and teaching away from the technical direction in which the patentee went by those skilled in the art. *Graham v. John Deere* at 148 USPQ 467.

<u>*Unexpected Results*</u>

Embodiments of the invention encompassed by independent claims 9 and 18 demonstrate unexpectedly superior results over prior art devices. Generally, during heat sealing of portion control packaged condiments, the temperature variation across heat seal dies made in accordance with embodiments encompassed by independent claim 9 of this invention are substantially less than the temperature variation across heat seal dies made in accordance with the prior art (without heat tubes). Cigallio Declaration, ¶ 17.

Figures 1 and 2, below, are graphic representations of temperature distribution across the top and bottom sealing bars on a type of portion control sized condiment packaging machine called a multi-lane four-side seal pouch machine. Figure 1 illustrates a prior art form/fill/seal machine and Figure 2 illustrates an embodiment of the present invention, as described by claims 9 and 18 of this application. During actual commercial production, the prior art machine shows a temperature difference of 23 degrees F across the front sealing bar of the heat seal die and a 31 degree F difference across the back sealing bar of the heat seal die. Such variation across the width of these seal bars can result in insufficient heating and sealing of the pouches. As can be seen in Figure 2, with an embodiment of the present invention, these differences drop to 8 and 4 degrees F, respectively. Cigallio Declaration, ¶ 18.

The heat seal die of the prior art machine was made of steel and did not include heat tubes. The heat seal die of the invention embodiment was made of hardened 440 stainless steel and included heat tubes. Cigallio Declaration, ¶ 19.

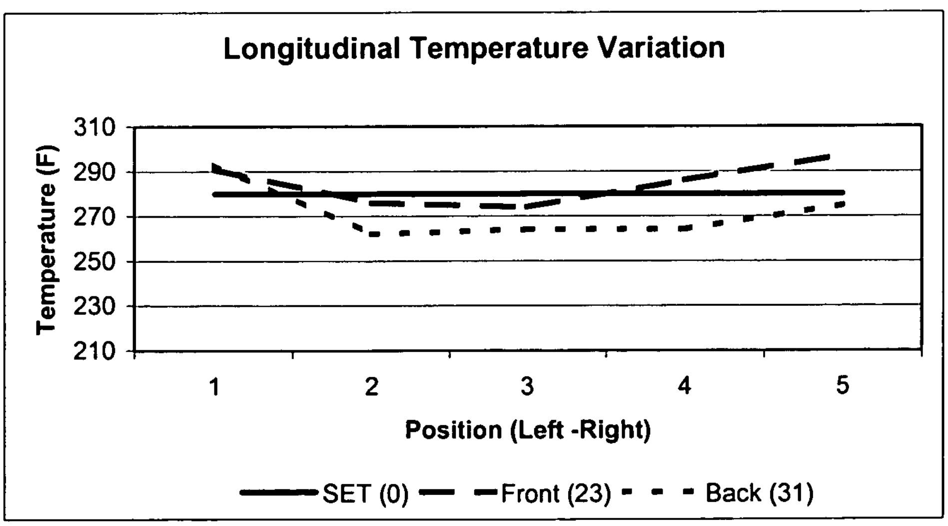

Figure 1: Operating Profile Without Invention

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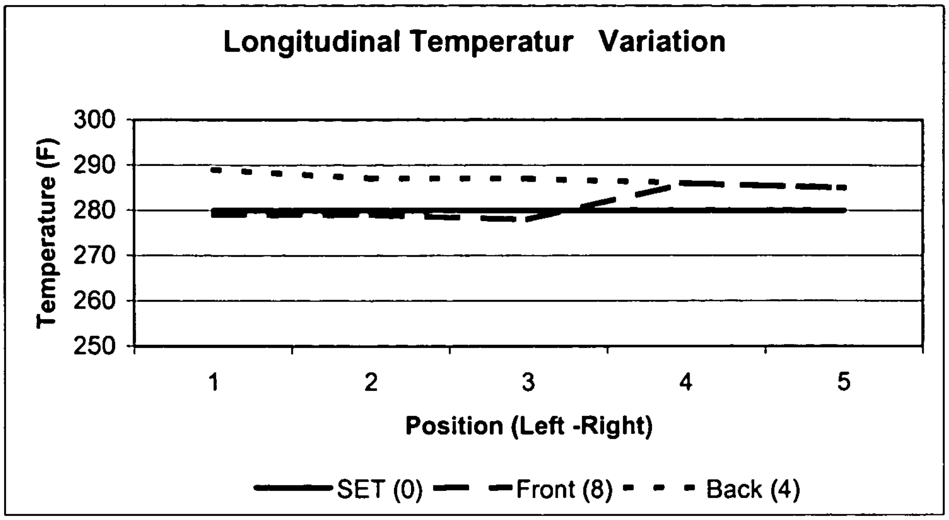


Figure 2: Operating Profile With Invention

Applicants submit again for consideration the unexpected results illustrated in Figure 2 hereinabove as evidence of nonobviousness. These results are particularly unexpected in view of the disclosure in the Nakamura Patent, which teaches that heat tubes are inadequate for controlling temperature in heat seal dies. Cigallio Declaration, ¶ 20.

Commercial application of embodiments of this invention have also been unexpectedly successful. Golden States Foods (GSF) is a licensee under this patent application and uses form/fill/seal machines for manufacturing portion control packaged condiments such as ketchup. GSF is the largest supplier of liquid products to McDonald's restaurants. Cigallio Declaration, ¶ 21.

In January 2002, the owner of this patent application, Printpack, in conjunction with GSF, installed embodiments of the invention encompassed by claims 9 and 18 of this application in a GSF liquid products plant in Conyers, Georgia. The embodiments implemented by Printpack and GSF were multi-lane, four side form/fill/seal machines for making portion control packaged condiments equipment with hardened stainless steel cross heat seal dies including longitudinal heat tubes (hereinafter the Embodiments). Prior to implementation of these Embodiments, GSF

operated this form/fill/seal machines with cross heat seal dies made of steel and lacking heat tubes. (the Prior Art Machines). Cigallio Declaration, ¶ 22.

The Prior Art Machines operated by GSF exhibited temperature variations exceeding 60°F across the cross heat seal dies, while specifications for the packaging film used normally set a 20°F variation. Such a discrepancy between film specifications for heat seal die temperature variation and actual cross heat seal die temperature variation in the Prior Art Machines reduced the seal integrity of the portion control packaging and increased the number of serum leakers. Cigallio Declaration, ¶ 23.

The Embodiments installed and implemented at GSF in January 2002 reduced the temperature variation across the cross heat seal dies to less than 10°F and thereby significantly enhanced the cross seal integrity of the portion control packaging produced. As a result, the number of cases of portion control packaged condiments withheld from distribution by GSF due to serum leakers dropped by 79% and labor necessary to rework such withheld cases dropped by about $75,000 annually. The reduction in serum leakers also enhanced the quality of product delivered to GSF's customers. Cigallio Declaration, ¶ 24.

Thus, the success of GSF in commercially operating embodiments of this invention is further evidence of the nonobviousness of the subject matter in claims 9 and 18 of this application.

Long Felt, But Unsatisfied Need

Reducing serum leakers in portion controlled packaged condiments has been a long felt, but unsatisfied need in the condiment packaging. Cigallio Declaration, ¶ 25. The publication titled "Portion Control and Flexible Packaging: A Reference Manual for the Dressings & Sauces Industry First Edition;" (The Association of Dressings & Sauces; August 1999; Atlanta, Ga; 150 pages) (hereinafter the "Manual") provides guidelines for portion control packaging of liquid

containing materials such as condiments and sauces. Applicants submit herewith this entire publication. This Association of Dressings & Sauces serves the market at which the invention described in the present application is directed. The Manual generally indicates that serum leakers are considered a serious problem in the portion control packaging industry. See *Manual,* pages 132-137. The Manual advises as follows:

> "Packaging films have changed dramatically over the last 20 years, yet serum leakers were there then and they are still here now. Studies have been done varying sealant materials and sealant thickness along with packaging machine conditions."

See *Manual*, page 134.

The Manual speculates that "gathering of the film and subsequent wrinkles may be the cause of most serum leakers." See *Manual* page 132. The *Boeckmann* patent cited in the Office Action also focuses on wrinkles as the source of the problem. The Manual suggests that portion control packaging machines must be maintained very diligently to minimize serum leakers. See *Manual,* page 134.

In "Table 8-4-Leaker analysis for Problem Solving", the Manual describes seven (7) types of defects from leaking, three (3) of which involve seal area faults.

Observed Defect	Possible Cause	Pattern	Action
Unsealed Seam Areas [5 of 7] 1)	Inadequate amount of sealant	No bonding in seal area. Gaps or spaces in seam	Confirm thickness of sealant layer against specification
2)	Defective composition of sealant layer	Reduced bond strength in seal area. Seam degenerates over storage	Packaging material defect
	Sealing temperature	No bonding in seal area.	Test and verify

3)	too low on sealing bars	Leakers occur in same lane of equipment	temperatures of heat seal bars. Replace units as needed
4)	Inadequate pressure on sealing bars, or poor mating of sealing bars	Reduced bond strength in seal area. Leakers will occur in repeat locations	Verify pressure with pressure sensitive paper. Replace springs as needed
5)	Inadequate dwell time on sealing bars	Reduced bond strength in seal area. Leakers occur in repeat locations	Reduce operating speeds. Timing adjustment
Cracks in seal area. [6 of 7]	Excessive pressure on sealing bars	1) Small breaks across seal area, or localized 2) Melted appearance or fracturing at seams	1) Adjust equipment. 2) Reduce and verify sealing bar temperatures
Serum Leakers after 30 days [7 of 7]	Excessive heat or pressure on the package in storage may contribute to serum leaker occurrence from any cause	Serum leakage from package during storage. Very small seam interruption	Reduce storage effect if possible. Increase grade of corrugated material if needed.

Manual, Pp. 80-82

The *Manual* is a current summary of industry beliefs and practices presents conflicting views on the causes of and remedies for leakers in multi-lane portion control packages. High temperatures and pressures are implicated in some cases (Table 8-4, 5.3, 5.5, and 6.2), while Appendix A No. 4 blames low temperatures and pressures. The one potentially consistent remedy, "reduce operating speed" (Table 8-4, 6.2) is not an economical option. While mention is made about "adjusting" and maintaining the performance of the packaging machinery components, no consideration is given to the ability of the machinery to maintain the tolerances

necessary to prevent leakers and there is no recognition that uniformity of temperature across the heatseal die causes leakers. Cigallio Declaration, ¶ 28.

Furthermore, according to cited U.S. Patent 3,677,329 issued to *Kirkpatrick*, heat tubes have been available for over thirty years, but to Applicants' knowledge, they have not been implemented in portion control sized packaging heat seal dies until Applicants' invention. This could be due to the prior understanding in the art that heat tubes will be unsuitable, as taught by the *Nakamura* Patent. Cigallio Declaration, ¶ 29.

The long felt need for reducing serum leakers in portion control size packaged condiments is finally satisfied by the invention described in the claims of the present application. The combination of the long felt need for reducing serum leakers and the concurrent availability of heat tubes and other endeavors establishes the nonobviousness of the system and method for portion control size packaging described in the independent claims of this application. Applicants respectfully submit that with this evidence of nonobviousness, the obviousness rejection based on *Nakamura* and *Boeckmann* is overcome.

Commercial Success, Licenses, and Replacement of Prior Art Devices

The owner of the Application, Printpack, currently has licensed this technology to two producers of portion control-packaged condiments: C.F. Sauer, Mauldin, SC (CFS) and Golden States Foods, Conyers, GA (GSF). Both of these companies produce portion control-packaged condiments for a variety of fast food restaurants. Dougherty Declaration, ¶ 3.

The licenses referenced above are contingent on the sale of specified amounts of packaging material sales by Printpack to the licensees over the next several years. Under the licenses, Printpack replaced the existing heat seal dies in the licensee's form/fill/seal machines for production of portion control sized packaging and supplies 60% of the licensees packaging material volume for portion control packaging at the same price provided by competitors. In these cases, Printpack and the licensees cooperated in experiments that demonstrated the

effectiveness of the technology. The licensing arrangements were made due to direct contact by Printpack representatives with the licensees. Printpack's advertising of the claimed invention was limited to this direct contact. Therefore, the commercial success of the claimed invention is not due to pricing or advertising, but rather, the technology itself. Dougherty Declaration, ¶ 4.

This commercial success, including the licensing of the technology and the replacement of prior art machines and operation with embodiments of this invention, is further evidence of the nonobviousness of the subject matter of claims 9 and 18 of this application.

Prior Art Teaches Away

Lastly, as explained in detail hereinabove, the fact that those skilled in the art taught away from the use of heat tubes in heat seal applications according to the Nakamura patent is still more evidence of nonobviousness of the subject matter of independent claims 9 and 18.

Applicants respectfully submit that the evidence of the non-obviousness of claims 9 and 18 is overwhelming and the rejection of those claims should be withdrawn.

Conclusion

The foregoing is submitted as a full and complete response to the Office Action and the allowance of all claims is respectfully requested. If there are any issues which can be resolved by a telephone conference or an Examiner's Amendment, the Examiner is invited to call the undersigned attorney at 404.853.8064.

Respectfully submitted,

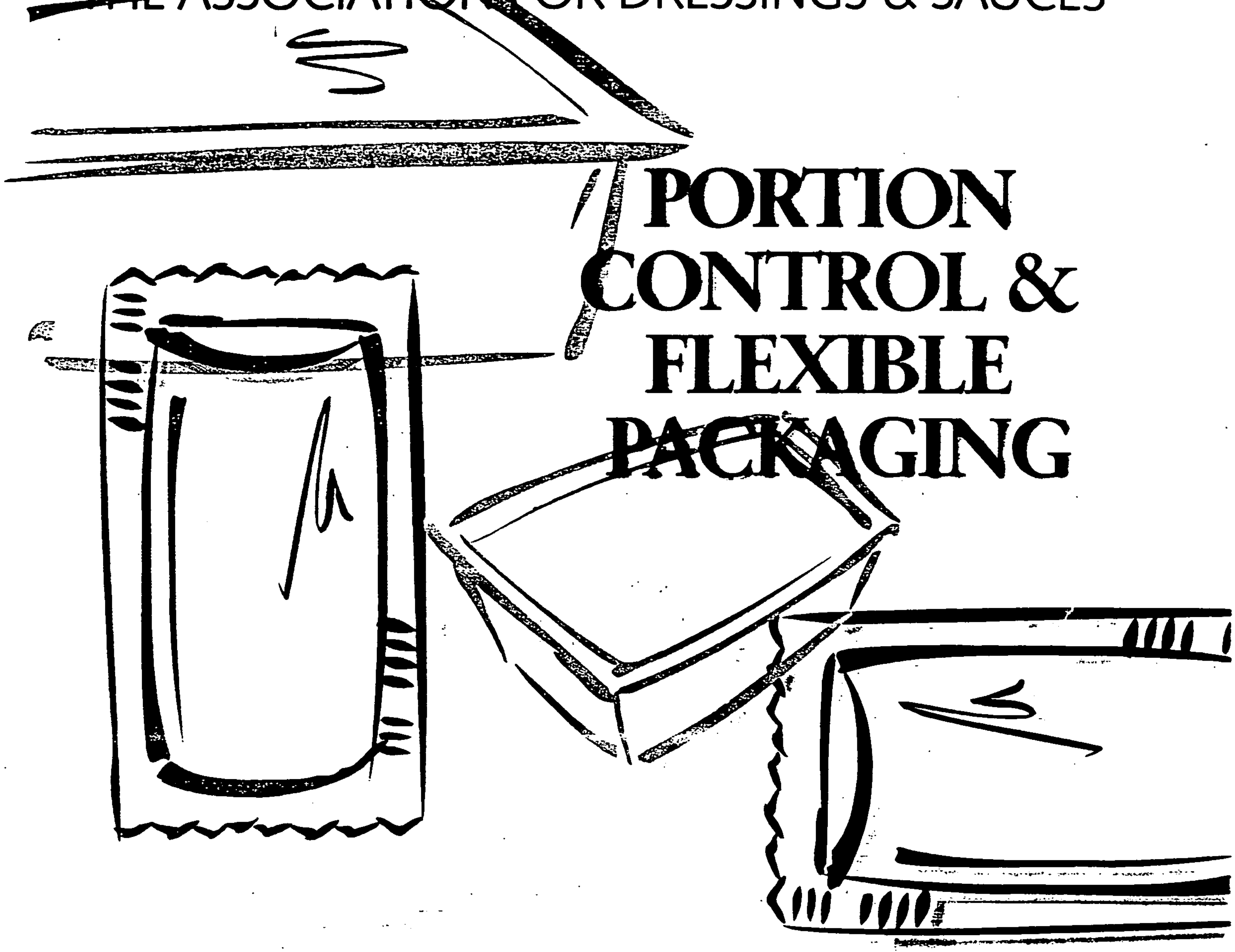
Peter G. Pappas

By: Peter G. Pappas
Reg. No. 33205

SUTHERLAND ASBILL & BRENNAN LLP
999 Peachtree Street, NE
Atlanta, Georgia 30309-3996
Telephone: (404) 853-8000
Facsimile: (404) 853-8806

Docket No.: 17244-0129

THE ASSOCIATION FOR DRESSINGS & SAUCES



PORTION CONTROL & FLEXIBLE PACKAGING

A REFERENCE
MANUAL FOR
THE DRESSINGS
& SAUCES INDUSTRY

First Edition

THE ASSOCIATION FOR DRESSINGS & SAUCES

PORTION CONTROL
AND
FLEXIBLE PACKAGING:

A REFERENCE MANUAL FOR THE DRESSINGS & SAUCES INDUSTRY

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FOREWORD

This Manual is made available to Association members to provide basic information regarding the portion control and flexible packaging industry. The Manual will serve as a guide to help ask the appropriate questions and seek the optimal solutions for selecting and using packaging materials and equipment in plants. Additionally, it will serve as a guide in developing a program to assure the optimal package is being formed consistently.

The development of this Manual was made possible because of the valuable input and expertise of members of ADS' Portion Control/Flexible Packaging Committee. The many years of experience among these individuals are reflected in the Manual, and we would like to express our appreciation for the contributions of the following individuals:

Kristen Anderson, Kraft Foods, Inc.
Kyle Anderson, Green Garden Food Products
Phillip Barnard, Curwood, Inc.
Tom Bremble, Curwood, Inc.
Beth Dammers, Kraft Foodservice
Steve Davis, Winpak Lane, Inc.
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Bruce Grenda, Sealmart, Inc.
Earl Hatley, Allied Signal
Dennis Howard, Bemis/Curwood/Milprint
Don Lander, Hassia USA
Bill Lane, Winpak Lane, Inc.
Bob Lepoir, The Clorox Company/HV Mfg.
Russell Masters, The C.F. Sauer Company
Jane Macdonald, Golden State Foods
Merle Lahti, ClearLam
Jerry Miller, Curwood, Inc.
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Peter Stone, Sealright
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Bill Wright, Barrier Films
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Richard E. Cristol
President

Pamela A. Chumley
Executive Director

Jeannie Milewski
Manager,
Regulatory & Technical Affairs

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CHAPTER 1

INTRODUCTION

This chapter outlines basic areas to consider in selecting the appropriate package.

A. PACKAGE SELECTION

Selecting the appropriate packaging system for flexible as well as rigid portion control containers involves many different considerations. These include product protection, machineability, marketing, costs, availability and regulatory considerations. Input from a number of different sources is required to select the optimal package, including from within the company as well as customers and their customers (final end users) and suppliers of materials and equipment.

The best place to start in selecting a packaging system is to do a survey and ask some key questions. Do not expect to have all of the answers! However, this will begin the iterative process of selecting a package system for the product.

Product Characteristics

- It is best to start with an understanding of the product to be packed. Is the product susceptible to damage from moisture, oxygen, light or other environmental factors? Is the product fragile and need physical protection? Are there any ingredients in the product that may affect the package material? What is the expected or needed shelf life of this product? What is the expected distribution method? What is the end use of the product? A dipping sauce, for example, may best be served by a rigid portion pack container.

- What materials will protect the product from detrimental outside forces? Which ones provide the best barriers to spoilage or damage?

- What kinds of seals should be used? How strong should they be? What kind of equipment will the end user utilize for closing the package, and does the sealing method work on the existing packaging equipment?

Machineability

- If the package fulfills all the protection requirements, it must then work into the end user's packaging operation. Does the material used provide for good production speeds with little or no stopping or "downtime" for the end user?
- Does it seal quickly, easily, effectively?
- Does it cut, form and move well through the packaging line? Is packaging speed critical?

Marketability

- Most importantly, to whom will the product be marketed and what graphic styles appeal most to this market?
- Very often, th packag is the primary el ment which s lls th product insid , and so it must "speak" to the customer. Do the graphic elements (e.g., illustrations, type, photography) used appeal to most customers?

- Does the package design stand out from other competitive products nearby on the shelf? Does it get noticed? Is it easy to open by the final end user?

Cost Effectiveness

- Generally speaking, flexible packaging is one of the most economical of all the packaging used today. Do all materials in the structure work together effectively to provide the best value for the end user?
- What kinds of profit margins are typical for the end user? Are margins tight and stringent, requiring packaging costs to be kept to a minimum?

B. REGULATORY CONSIDERATIONS

Packaging materials that are intended to be in direct contact with foods must not adulterate or misbrand the food within the meaning of the Federal Food, Drug and Cosmetic Act (FFDCA), as now in effect, under Section 303(c)(2), and such products are not articles which may not, under the provisions of Section 404 and 405 of the Act, be introduced into interstate commerce. For example, one may want to consider trap printed packaging in direct contact with food versus surface printed packages. Packaging materials used in an official USDA establishment must be covered by a Guarantee or a Letter of Assurance, in accordance with the Federal Meat Inspection Act, 9 CFR 317.24(b) and the Poultry Products Inspection Act, 9 CFR 381.144(b), from the packaging supplier under the brand name and firm name that the materials are marketed to the establishment. The Guarantee must state that the material's intended use complies with the FFDCA and applicable food additive regulations.

CHAPTER 2

WEB BASICS

This chapter explains the web basics, including construction, production, handling and storage.

A. WEB CONSTRUCTION

1. The Substrate

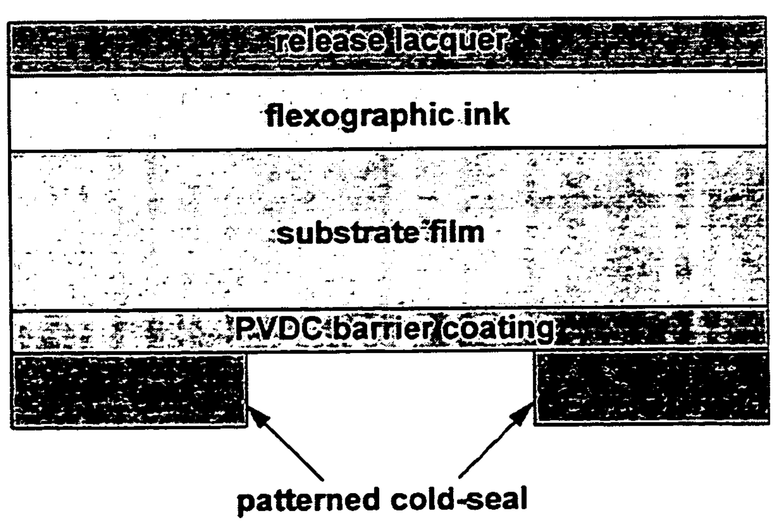
The roll of paper or film used in the packaging industry is called the web. A variety of inks, lacquers, adhesives, coatings and sealants may be applied to the web. It can also be called a carrier sheet because it "carries" all these other components. Another name for the web can be a substrate. Webs or substrates may be either monolayer structures or composites of different materials.

If a cross-section of a web was viewed under a microscope, the applied materials may appear as layers (see Figure 2-1). The specific makeup of these layered components forms the structure. Different structures are assembled to provide special and precise properties for a particular packaging product to meet specific requirements, such as the type of food being packaged, the protection of the product and the packaging equipment. The protection could be against abuse during shipment, protection from outside contaminants or from rancidity caused by oxygen permeation.

In order for a flexible package to be sealed, every film must have a sealant layer, generally comprised of polyethylene. To add other properties to the film, other layers are incorporated in the structure. If a product is shipped refrigerated or at room temperature, is not oxygen sensitive and is not hot-filled or rethermalized, then a polyethylene monolayer film is the most efficient, cost effective flexible packaging structure. High impact polystyrene would be the most efficient, cost effective monolayer web for rigid packaging applications.

Figure 2-1

CROSS-SECTION OF A WEB STRUCTURE



As previously mentioned, the material used as the base web of the structure is called the substrate. It can be either paper, plastic film or metal foil. Most films themselves are actually multi-layered to give additional properties. The processes for producing multi-layered films will be discussed later in this section.

When designing a product, the substrate material for the web must be carefully chosen for specific performance needs, efficiency of manufacturing and cost. Foil has many desirable traits for example, but it tends to be more difficult to achieve good, consistent ink adhesion to its surface during manufacturing. The process of metalizing, where a thin layer of metal is vapor-deposited on the surface of a plastic film, produces another type of material that may be selected for the web.

The chart below lists some of the types of materials used in each class of substrate:

PAPER	PLASTIC	METAL
	Polystyrene	
Kraft	Polypropylene	Aluminum Foil
Bleached MG	Polyethylene	
Tissue	Polyester	
Pouch	Nylon	

2. Web Structures

a. Asymmetric Structures

Frequently, web structures are referred to as asymmetric (unbalanced) or symmetric (balanced). An asymmetric structure only has sealant on one side of the film. Generally, the structure would be of this nature: sealant/barrier/abuse layer. An example of a flexible packaging machine that runs an asymmetric film is a Lane L-18 or a Hayssen. Asymmetric film makes packages with fin seals or a package with four side seals.

b. Symmetric Structures

Conversely, a film with sealant on the inside and outside is called symmetric (balanced) structure. Two common symmetric structures are sealant/abuse/sealant or sealant/abuse/barrier/abuse/sealant. A package that has a vertical lap seal uses a symmetric structure. Flexible packaging machines that use symmetric or balanced film are Onpack and Prepacs.

c. Print d Film

It is possible to print on most films. Film can b surface printed or trap printed. Surface print is a techniqu that only prints the surface of the

film and can be used with laminates or coextrusions. Only laminates can be trap printed. Trap printing can also be called sub-surface printing or rev rse printing since the graphics are printed on the reverse side of the web. In trap printing, a layer of film is printed, then the printed side is laminated to another layer of film. The layer of film above the print results in a glossy appearance. It also protects the print from being removed if the film is scratched or abraded. Surface print is not as glossy. Generally, trap printing is more expensive than surface printing due to the complexity of the procedure.

d. Pigmented

It is not recommended to print the entire film surface. Printing ink should not be in the vertical seal area or an adequate vertical seal will not be formed. To obtain a solid color over the entire structure, a pigmented film should be used. In the extrusion process, color pellets can be added to the resin to create a pigmented film. White is a common pigmented film color. Pigmented film can be printed. Generally, pigmentation is a more economical process than printing.

B. WEB PRODUCTION

As previously noted, substrates may be made of one or more layers depending on the desired properties. Basically, there are two types of processes by which multi-layered films are produced: extrusion and lamination. Extrusion and coextrusion lamination also will be addressed.

1. Extrusion

Extrusion is a process where melted resin is forced through a die to form a web of a desired thickness and predetermined width, based on the maximum width of the die. The die is usually adjustable through the use of a series of cap screws spaced closely together all across the die. Tightening the cap screws reduces the web thickness at that point, while loosening them increases the thickness.

To achieve a web that is uniformly thick from edge to edge takes very careful adjustment of the cap screws. Some newer types of dies have a non-adjustable, precision-milled orifice cut into the width of the die. The intent is to produce a die which gives optimum sheet thickness with less variation across the web. Each die, however, can only be used for one thickness - extremely costly if more than one thickness (die) is needed.

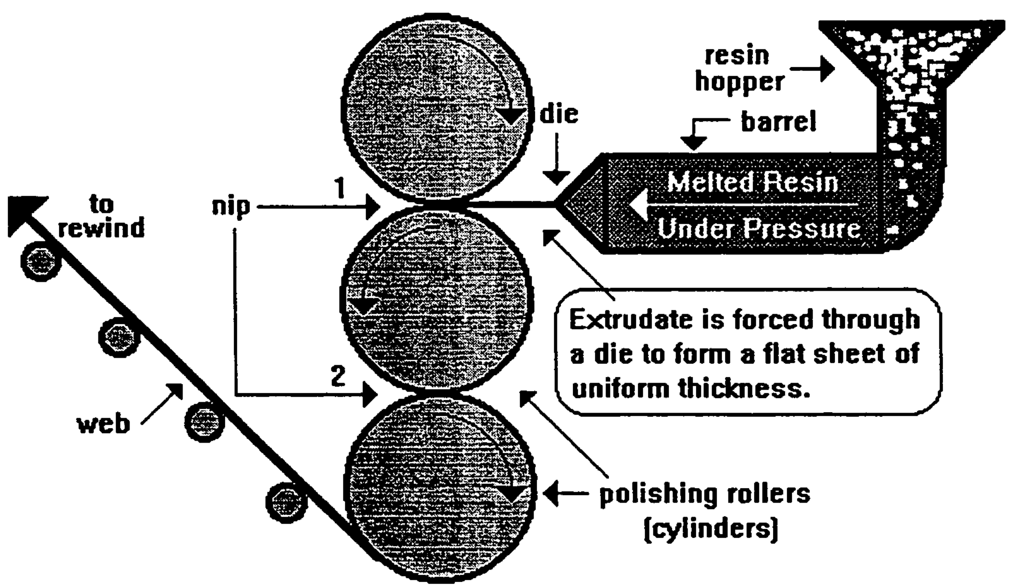
Resin, usually in the form of beads or pellets, is fed through a hopper into a melting chamber. Once melted, the resin flows into the barrel of the machine. It is then drawn through the barrel by a long xtrusion screw towards the forming die. As the r sin trav ls along inside th barrel, the screw applies increasing amounts of pressure on the resin until it v ntually extrudes, or is forced out, of th die as a smooth, uniform sheet.

The hot flat sheet is pulled through a precisely-sized nip formed by two stainless steel polishing rollers which are chilled to cool the web. This smooths the sheet further and brings it closer to the target thickness. It travels around the lower roller of the first nip, through a second nip (to set the final thickness), around the bottom (lower) roller and finally, is wound up as a master roll on the rewind stand.

While the hot surface of the web (called the extrudate) is in contact with the polishing rollers, it becomes embossed with the surface-roughness characteristics of the polishing rollers. The finished sheet takes on the same glossy or matte appearance as that of the roller surface. The web is sufficiently cooled after being released from the last rollers to maintain its shape and thickness. Additional air cooling takes place as it travels along toward the rewind station. The master roll can then be used for other converting operations, such as laminations, used as is, or slit to a finished roll size. Figure 2-2 depicts the extrusion process.

Figure 2-2

THE EXTRUSION PROCESS



In the extrusion process, only one type of resin is used, such as linear low density polyethylene (LLDPE), and the film is generically called a monolayer. If two or more different types of resin are extruded, for example LLDPE and high density polyethylene (HDPE), the process is called a coextrusion. The resulting web is also called a coextrusion because of the multiple layers of web types. In the coextrusion process, the die combines one layer of film with another layer of film with heat and pressure. The coextrusion process will be discussed in greater detail in the next section.

2. Coextrusion

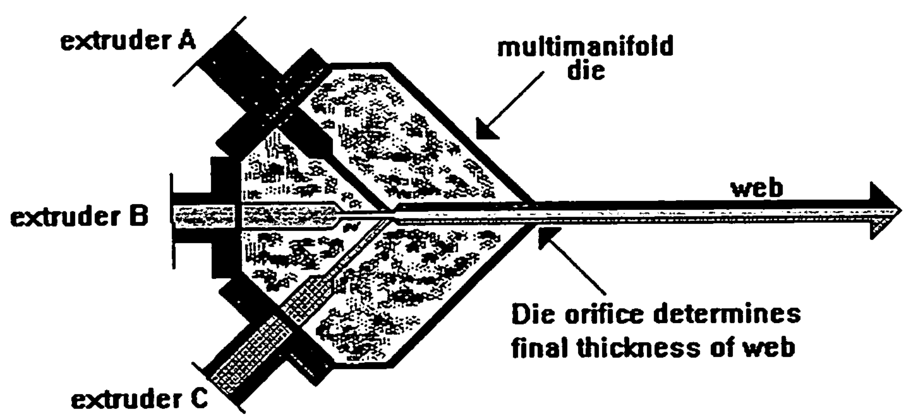
Coextrusion refers to the process of bringing two or more extrusions together to form a composite, layered structure within a multi-manifold die. It can be designed to give very precise properties, especially in the areas of producing webs which may be used as substrates for manufacturing flexible packaging and multi-layered substrates for rigid packaging. Several webs can be "married" (becoming as one) together in a single process with excellent uniformity and quality.

Multiple extrusion barrels feed into individual manifolds within a common die. The separate resins are cast (laid down) upon each other, bonded from the heat and pressure, then are extruded out the end of the die to form the finished, composite web of desired thickness (see Figure 2-3). Each layer may be made from a single resin type or a blend of resins. Resins can be bonded into multiple layers until all performance criteria for a packaging material design are met. The web becomes a layered structure that cannot be separated and will not delaminate. Usually, two to five layers can be joined through coextrusion.

Figure 2-3

MULTIMANIFOLD COEXTRUSION TECHNIQUE

(Method of Joining Materials in the Die)



Coextrusion can be a costly internal process, be difficult to set up and require demanding control during manufacture. Despite these factors, the unique performance benefits this extruded substrate provides to customers could help them develop specialized product applications in competitive markets or meet their need to maintain or improve product freshness.

3. Lamination

The process of bonding two webs together is called laminating. Webs may be bonded by adhesives developed for this purpose, or married together during another process called extrusion lamination, which will be discussed later in this section. As detailed previously, extrusion creates a web by melting plastic resin and forcing it through a die under high pressure. The hot web then passes through a nip (gap) between two large stainless steel polishing rollers which press and polish the web into a uniform thin sheet of a specific thickness and gloss. During extrusion, a secondary web of film or additional extrudates can be laminated to the hot extrusion prior to its passing through the nip to form the laminated structure. In fact, many plastic substrates are laminates made from multiple extruded webs.

It is important that the adhesive selected for the lamination be strong enough to keep the laminated webs from de-laminating (separating) during the remaining processing and also the entire time of the food product's shelf life. The purpose of using a laminated structure is to be able to combine the performance aspects and strength of two or more web materials for significant gains in protection for the packaged food product. Any separation of layers severely compromises that protection. The lamination should also be very smooth across and down the entire web, with no wrinkles or bubbles of trapped air. Any deviation in the quality of web consistency can affect overall product performance and aesthetics.

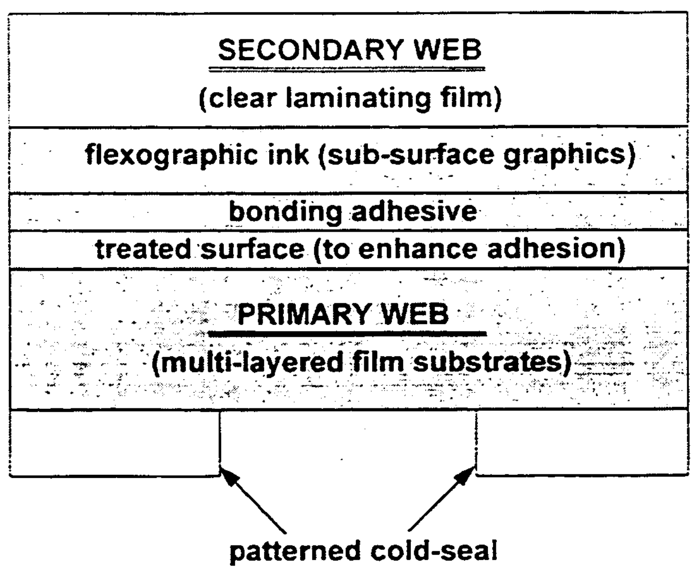
Some applications use a laminated structure to protect the graphics of the packaging by printing the ink on the inside layer of one of the clear laminating webs. This is called sub-surface printing or reverse printing since the graphics are printed on the reverse side of the web. It not only gives the package a high gloss appearance, but also protects the graphics from possible abrasion because it is protected within the laminated structure.

Figure 2-4 illustrates a treated surface as one of the layers. The different types of treatment will be covered in Section C; however, note that it is generally necessary to treat the surface in some fashion to enhance the laminating bond str ngth of the entire package; or also for improving ink adhesion. For some bag structures, the patterned cohesive is replaced by a PVC (polyvinyl chloride) coating which covers the entire web. This is a sealant which forms a bond when the bag is folded over on a customer's packaging machine and the sealant layers are pressed together under heat from the clamping part of the machine, called the "jaws." The sealing process is called a "heat-seal" because it requires both heat and pressure to adhere the package together to form a bag. The product is then dropped into the bag and the top of the bag is similarly sealed. The seal must be of sufficient strength to hold the product without coming apart. The machine used for this bag packaging process is called a vertical form and fill machine (VFF).

Figure 2-4

CROSS-SECTION OF A LAMINATED WEB STRUCTURE

(sub-surface printed)



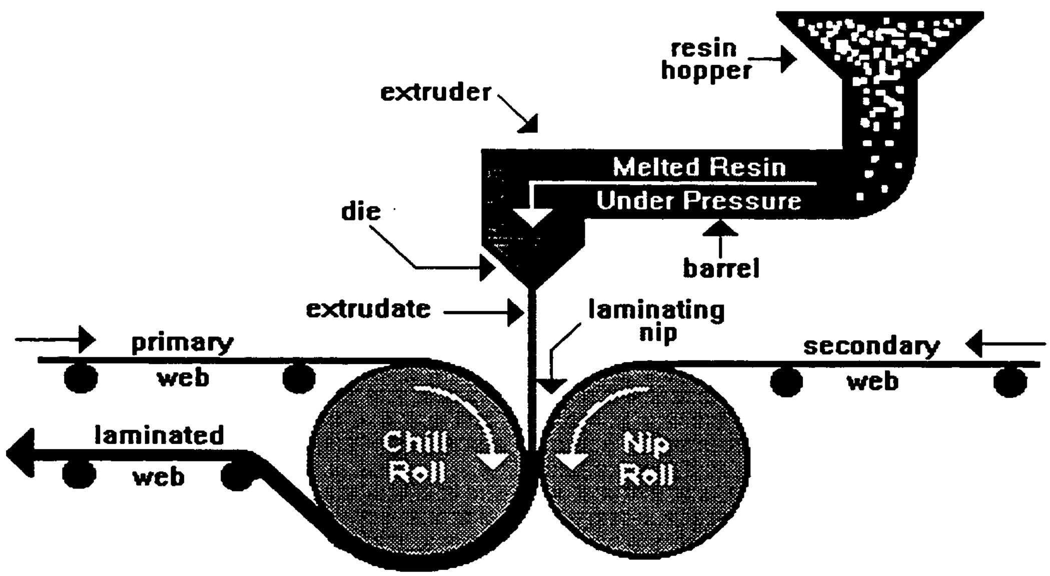
4. Extrusion Lamination

In extrusion lamination, the extrusion web is cast, or applied, between two separate webs of film before moving through nip rollers to optimize total laminate thickness.

The two film webs bond to each side of the extrudate (extruded w b material) by the heat of extrusion, the nip roll pressure, the chemical sealant present on the film and the natural affinity (attraction) of each web surface. The web is chilled while in contact with the chill roller to set the bond as it moves to the rewind station of the press where it is wound into a roll (see Figure 2-5).

Figure 2-5

EXTRUSION LAMINATING



The finished substrate gives desirable properties of both film and extrusion with great package strength and barrier, depending on the type of resins and films used. It is possible to form this product into trays, or other dish or bowl-type packages, where maintaining product freshness is critical to avoid spoilage. An example is packaged meat trays. The rigidity of the packaging material allows it to be used in unique applications, offering superior toughness, leak protection and other performance properties.

C. COATINGS AND ADHESIVES

1. PVDC (Polyvinylidene Chloride)

Polyvinylidene chloride's (PVDC) primary function for use is as a barrier coat to prevent moisture and odors from penetrating the sealed package. Films, by themselves, are porous. Through the process of osmosis, they will allow air and moisture to pass through them, which could severely affect the shelf life (freshness) of the packaged food product. PVDC coating of a product reduces, but does not entirely eliminate, what passes through the package. Package constructions can be tested for the rate of penetration of these contaminates, i.e., Moisture Vapor Transmission Rate (MVTR) and Oxygen Transmission Rate (OTR).

2. Primer

A primer is a thin, dilute coating applied over the entire surface of the web to enhance the bond strength of the laminating adhesive to the surface of whatever it contacts. In the case of sub-surface graphics, the primer would be applied over the printed ink. This does not affect the graphics because the side viewed by the consumer is already protected by it being printed to the secondary web. At times, the components used in a particular construction, designed and brought together to give specific performance properties, do not have an adequate affinity, or attraction, for each other in a lamination. This results in an unacceptably weak lamination bond with a high probability of package failure. A primer, which could be made of a dilute (3% solids content) solution of the laminating adhesive, increases that affinity to an acceptably high level - resulting in adequate (or better) lamination strength for use as a finished packaging product. Note that the solids content of a coating is simply the amount of the solid mass contained per quantity of coating versus the liquid, or solvent, portion; typically expressed as a percentage of the total.

3. Adhesive

Adhesives can be made from rubber, natural or synthetic or acrylic resins and, thus, are referred to as rubber-based or acrylic adhesives. Rubber-based adhesives combine the various ingredients of rubber for elasticity, resin for tackiness or grip, powders used as fillers to add bulk or mass, antioxidants to prevent degradation, and catalysts to "cure", or solidify, the adhesive for just the right amount of adhesion to the surface it is applied. The rubber must first be processed, or milled, to tear its long chains of molecules into smaller ones in order to help the rubber dissolve in the solvent and to obtain the desired performance properties of the adhesive. The amount of molecular breakdown is measured as its Mooney viscosity measurement on a special test apparatus. For optimum performance of any rubber-based adhesive, it is critical to control the rubber-to-resin ratio of the adhesive formula within a certain range. In other words, for any given amount (weight) of resin used in an adhesive formula, the amount of rubber to add must stay betwe n a tight range of a minimum and maximum value - not too much and not too little. Exceeding this ratio will result in adhesiv failure.

The problem with any natural rubber-based, or latex, adhesives (as cohesives discussed later) is that they tend to be inconsistent in performance from batch to batch. Natural rubber is taken from trees; therefore, the variations in growing conditions can result in chemical differences in the rubber itself. This translates to variability in how the rubber behaves in an adhesive formula. The simple solution would be to switch to a synthetic, or artificially created, rubber where specific and uniform performance could be chemically controlled.

Unfortunately, and especially for cohesive formulas, synthetic rubber is not easy to use in a water-based solvent system. It can produce a variety of handling problems during the Rotogravure coating operation, such as excessive foaming, or becoming thixotropic - a condition where the liquid solution is so imbibed with air that it forms a kind of a foamy gel that can be stirred, but will not flow.

Acrylic-based adhesives are simply acrylic resins dissolved in a solvent. They are water clear in color and generally offer aggressive adhesion performance for a relatively small amount of coated mass. Thus, they can be applied very thinly over a web while providing outstanding adhesion and aging properties, depending on the acrylic resin chosen. An example of a high performance acrylic adhesive is what is used on automobile license plate stickers. Despite being subjected to extremes in weather conditions, the stickers continue to adhere if properly applied to a clean, dry surface.

Acrylics do not adhere well to themselves and, therefore, cannot be used as a cohesive, as is discussed later. To determine what kind of adhesive has been applied to a label, for instance, bend it so the adhesive surface contacts itself and press it together. If it can be peeled apart cleanly so that the adhesive of both contacted sides remain virtually undisturbed, it is most likely an acrylic adhesive. This class of adhesives are called pressure-sensitive adhesives. They need to be applied with pressure on to the mounting surface to obtain their maximum designed adhesion performance.

4. Cohesive

A cohesive is a type of adhesive that is designed to stick to itself. This is termed, "face-to-face" adhesion. It also must adhere to the surface on which it is coated. Since no heat and minimum pressure is needed to form a seal, this class of materials is called cold-seal adhesives. It has been demonstrated and proven that packaging run speeds and efficiencies can be greatly increased through the use of cold-seal adhesives to seal product packages because it seals without heat.

A properly performing cold-seal adhesive should give good bonding performance and show a combination of good substrate adhesion and "legging", or cohesive failure when the seal is pulled apart. Legging is the long strings of adhesive that stretch between the two web pieces that have been bonded together when being separated. This indicates that both cold-seal layers have migrated together to form a strong bond which can only be broken apart using xcessive force during separation of the two web pieces. Gen rally, a strong bond gives a higher, desired performance.

Cold-s al is a latex (rubber)-based adhesiv that is mixed with water as the carrying solv nt. It is applied to the web by the process of Rotogravure printing as a thin mass

on the web. Gravure printing uses a cylinder etched with tiny cells to carry the coating and apply it to the web. Each wrapper produced has the cold-seal applied in a pattern around its perimeter.

D. WEB STORAGE

Film, like stable food ingredients, should be stored in a room that is dry and in the temperature range of 40° to 70° F. Film can pick up moisture and become tacky and difficult to run on the equipment. Also, ethylene vinyl alcohol (EVOH) films tend to be hygroscopic which causes their barrier properties to deteriorate over time. High temperatures can cause a change in film surface characteristics, such as increasing the surface friction, resulting in machining difficulties. Consequently, it is best to store webs in a cool, dry place.

E. WEB HANDLING

The proper handling of film is important for its optimal performance and to reduce the incidence of unusable film, which can be costly. For example, rolls that are removed from pallets and are tipped on their side onto a cart causes excessive edge damage and unusable film. Therefore, a Tilt-loc device should be used to pick up the roll from the core, tilt it at a 90 angle and then set the roll on the cart. The cart should have a larger radius that the biggest roll it will carry and should be covered by 0.5" to 0.75" felt to prevent damage.

To prevent damage in the staging area, rolls that are restacked on pallets should have cardboard headers between them. Additionally, pallets should not be double-stacked unless the top layer of the bottom is well protected with a reinforced cardboard topper.

CHAPTER 3

RESIN AND FILM PROPERTIES

This chapter provides information on various resin and film properties to enable the manufacturer to select the appropriate packaging system.

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A. BARRIER PROPERTIES

Barrier properties are an important consideration in selecting the appropriate packaging material for a product. It is necessary to determine what barriers are required for a given application.

All polymer systems, to a greater or lesser degree, are permeable; that is to say that small molecules of water, oxygen and carbon dioxide pass through the packaging material. The detrimental effects on the food product, such as the loss of taste, color, texture or moisture content, depends on the particular sensitivity of the product being packaged.

In some cases, there may be a chemical reaction with the packaging material, resulting in the loss of structural integrity of the package. Processing conditions, such as filling temperatures, the use of gas flush and environmental conditions, for instance relative humidity and temperature cycling in storage, place additional demands on the packaging materials.

Caution should be exercised when using tabulated data on permeability. In most cases, the data should be used as a guide to the relative order of magnitude of permeability of various materials. In reality, many factors, such as density, crystallinity, orientation, crosslinking, fillers and the method of manufacture, affects a polymer systems permeability. Empirical testing is the only reliable method of determining the suitability of a packaging system.

1. Major Barrier Considerations

- *Oxygen* - Measured as Oxygen Transmission Rate (OTR). Oxygen affects color, flavor and bacterial growth. With oxygen sensitive products, there are two main oxygen barriers used -- polyvinylidene chloride (PVDC) and ethylene vinyl alcohol (EVOH).
- *Moisture* - Measured as Moisture Vapor Transmission Rate (MVTR). This can directly affect the shelf life of moisture-sensitive products.
- *Flavor/Odor* - Generally measured by using organoleptic methods. Off-flavor and odor pickup can be affected by factors like time, temperature, container contact and the composition of the product. For example, high fat products tend to absorb odors more readily.

The remainder of this section will focus on the characteristics of various resins and films available for packaging systems.

B. COPOLYMERS

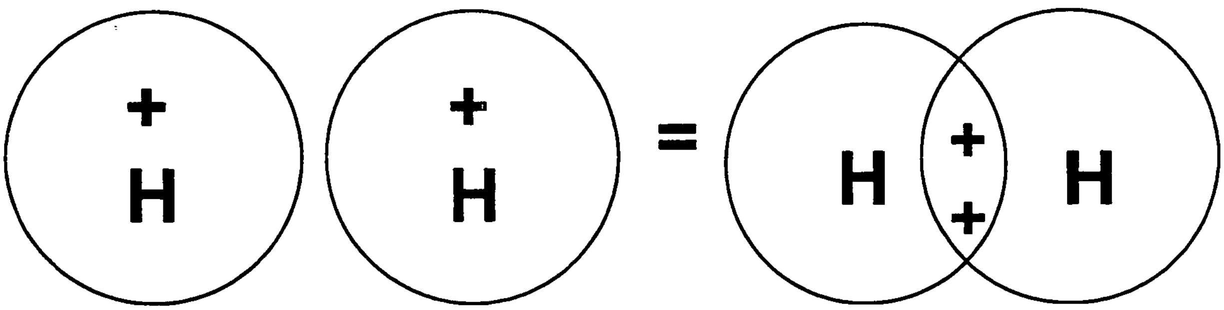
A copolymer is a polymer made from two different monomers. Remember that a monom r is simply one typ of molecule and a polymer is a substance containing many types of molecules.

Copolymers have a number of properties which monomers do not have, especially clarity, flexibility and resilience (the ability of a material to resume its original shape after being bent over a wide temperature range).

1. Ionomers

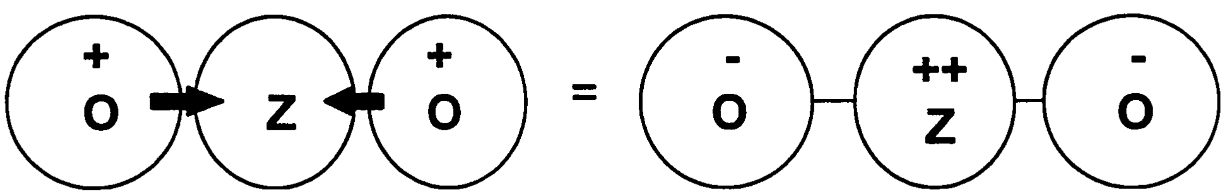
An ionomer is a thermoplastic containing both covalent and ionic bonds. A covalent bond is a chemical bond formed by the sharing of one or more electrons between atoms (see Figure 3-1).

Figure 3-1 - Covalent Bond



An ionic bond is a chemical bond formed by the complete transfer of one or more electrons from one kind of atom to another (see Figure 3-2).

Figure 3-2 - Ionic Bond



An ion is an atom, group of atoms or molecule having an electric charge acquired by gaining or losing electrons from an initially neutral configuration. A thermoplastic is a plastic which can be repeatedly softened by heating and made rigid by cooling. Thermoplastic polymers can be ionically crosslinked. Crosslinking is the setting up of chemical links between the molecular chains. So, a polymer ionically crosslinked would be one linked together by the transfer of electrons.

Th basic classification of ionomer resins refers to the type of metallic ions used to n utralize the acid reactivity. There are two main types: sodium- and zinc-based. Th sodium type has very good adh sion to foil and to other polymers in coextrusions.

While the distinctions between sodium and zinc types are important in general, the properties of any ionomer film with respect to these various parameters are superior to other films. Some of the main properties of ionomer films are low temperature heat sealability, formability, toughness, clarity, oil and solvent resistance and excellent adhesion to important packaging materials, such as nylons and foils. Also, ionomers stand up to repeated flexing and twisting, offering three times the resistance of polyethylene to pinholing.

Ionomers also have outstanding hot tack, which is the capability of a heat seal joint to bond together when it is stressed while still hot from the heat sealing operation. Hot tack is desirable:

- Where heavy weights of product are loaded into a recently made pouch on a form/fill/seal machine (e.g., products such as coffee, cocoa, milk powders, ground sugar).
- Where bulky products are tightly packaged in small packages with product tending to resist sealing at the edges (e.g., pharmaceutical powder pouches or suppository packages).
- Where vibration or cutting takes place while the seal is still hot (e.g., unit portion or alcohol towelettes, salad dressing, pill packages and vacuum packaging of meats or cheeses).
- Where form/fill/seal packages are filled hot (e.g., liquids such as tomato sauce or oils).

Films of ionomers show outstanding resistance to both physical and chemical attack. They are also highly resistant to permeation by liquids. However, some solvents do cause swelling and permeate through ionomers; therefore, they should be used with caution. Also, ionomer resins do not possess high gas barrier properties.

Ionomer films are used today in film packaging where formability, toughness and visual appearance are important. It is also used extensively as a heat seal layer in composite films for processed meats.

Ionomers provide significant increased value in use, but commands a significantly higher price for these advantages. The use of ionomers as a component in a packaging structure should be carefully considered and evaluated from both a technical and an economic standpoint to ensure that the customer is getting the optimum package performance for the price.

2. EVA Copolymers

Ethylene-vinyl acetate (EVA) copolymers are derived from basic low density polyethylene (LDPE) technology. The addition of vinyl acetate reduces polymer crystallinity, which increases flexibility and reduces hardness. EVA copolymers are polymerized (made into a polymer) under high pressure using reactors of the kind used to make conventional LDPE. In comparison to polyethylene, EVA copolym rs are more perm able to gases and water vapor, have good, but slightly poorer electrical properties, reduced chemical resistance and are less heat stable.

Film extrusion is the major application for EVA. The combination of high clarity, puncture r sistance, impact strength and low heat-seal temperature makes it desirable for flexible packaging. Typical applications include frozen food, dry soup and soft drink mix pouches, cheese wrap, pet food pouches and specialty meat packages.

3. EAA and EMAA Copolymers

Ethylene-acrylic acid (EAA) and ethylene-methacrylic acid (EMAA) are the result of copolymerizing ethylene with a carboxylic acid to produce a polymer having carboxylic groups randomly distributed along the molecular chain. Although these materials appear very similar to LDPE, the carboxylic groups interact between polymer chains/functional sites and between the polymer and various substrates. These interactions (temporary hydrogen bonding) explain this polymer's improvements in aluminum foil adhesion, hot tack, heat seal, product resistance and toughness. These interactions also cause these materials to be attracted to and stick to metal surfaces in machinery (e.g., knives in vertical form fill seal machines).

Acid copolymers are available in various grades with melt index values from 1 to 2600 and acid contents from 3% to 20% by polymer weight. This wide range of grades allows these "functional" copolymers to be converted into blown film, extrusion coatings and even specialized water-based primers for applications ranging from flexible food containers to corrosion protective pipe coatings.

4. EEA Copolymers

Ethylene-ethyl acrylate (EEA) copolymers are members of the polyethylene family. They resemble polyethylene in appearance, but have the flexibility of plasticized (softened) vinyls. They are produced by high-pressure polymerization techniques.

The introduction of an ethyl acrylate group in the polyethylene chain lowers the crystallinity of the copolymer. Reduced crystallinity results in greater flexibility and a lower melting point. Besides the effect on crystallinity, increased acrylate content makes the polymer more polar (easier to adhere), giving it toughness because of chain interaction. As may be expected, increasing the molecular weight improves various physical properties and decreases processing ease.

EEA copolymers can be made over a wide range of monomer content and molecular weight. They can range from rubbery, low melting products suitable for hot melt adhesives to polyethylene-like products that demonstrate unusual toughness and flexibility.

EEA copolymers have good tensile strength and high ultimate elongation and resistance to environmental stress cracking. They have been used in applications requiring flexibility and toughness.

5. EMA Copolymers

Ethylene-methyl acrylate (EMA) is produced in a conventional high pressure, autoclav reactor wh re a methyl acrylate monomer is injected into the reactor with the ethylene gas to produce a copolymer. An autoclave reactor is a pressure vessel normally used to steam sterilize.

EMA can be readily processed into blown films by use of a standard low density polyethylene (LDPE) film extrusion line. EMA film possesses extremely high impact strength and is easy to heat seal at low sealer temperatures. It is a good extrusion coating and extrusion laminating resin because of its inherently good thermal stability and adhesion to commonly used substrates.

EMA resins are routinely used in coextrusions with blown and cast film and coating dies, and are used to impart a heat-seal layer onto substrates.

6. EVOH

EVOH (ethylene vinyl alcohol) is a copolymer that exhibits the lowest gas transmission rate of all plastic materials. This polymer also provides excellent barrier to fragrances and aromas, as well as being highly resistant to solvents and chemicals. EVOH is typically used as a film layer, having outstanding optical properties.

The primary use for EVOH is in food packages, such as those used for meat and cheese, where oxygen barrier is critical to shelf life. EVOH does absorb moisture and loses some of its gas barrier when wet.

C. SUBSTRATE TYPES AND PROPERTIES

1. Polyethylene

a. The Manufacturing Process

Polyethylene resins are thermoplastics, meaning they can be repeatedly softened by heating and made rigid by cooling (just as ice can be repeatedly "softened" into water by heating and remade into ice by cooling).

To make polyethylene, high purity ethylene gas is required. Ethylene may be a petroleum refinery by-product or it can be made from natural gas coming through pipe lines from a gas field. In the latter case, a mixture of certain gases is first removed from the natural gas in an extraction unit. In a number of steps, a mixture of certain gases is removed from the gas. One of them is ethane from which ethylene and finally polyethylene are made.

Polyethylene film can be produced by either the blown film or cast film process.

b. Physical Properties

Polyethylene has properties which has made it rapidly become one of the most versatile and frequently used materials. Although it does not have all the properties of an ideal packaging material for many applications, it is widely used in combination with other film materials to secure the necessary protective requirements.

Polyethylene has low permeability to water and moisture vapor, and high permeability to oxygen, carbon dioxide and other gases. It heat seals instantaneously to itself and forms very strong seals. It also can be sealed to papers and paperboards when accompanied by high mechanical pressure. It is flexible and formable, retaining flexibility even at subzero temperatures.

Polyethylene is tough and resilient, with good resistance to tear and puncture. These properties are retained over a large temperature range. It is tasteless and odorless and has good machineability when used as a sealant or laminate.

c. Low Density Polyethylene

Low density polyethylene (LDPE) is probably the largest volume plastic produced in the U.S. The primary properties of concern for LDPE are density, melt index and molecular weight distribution.

Density is a measure of crystallinity, with a higher density indicating the presence of more crystalline regions. Changes in density or crystallinity affect a number of key properties. Tensile strength, stiffness and barrier properties all improve with higher density, while impact and tear resistance normally suffer.

Melt index is defined as the amount of molten resin that flows through a given orifice (opening) in ten minutes using a specific temperature and pressure. Resins with low average molecular weights flow faster; those with higher average molecular weights flow at slower rates. A greater average molecular weight (or lower melt index) generally improves most film properties, but requires higher energy to extrude. Tensile strength and impact properties are enhanced, but optical properties typically worsen with decreasing melt index.

LDPE is produced under conditions of high temperature and pressure. It has lower melting points and is generally more flexible. It is generally used for paper and film coatings because it is easier to seal and handle.

d. Linear Low Density Polyethylene

Linear low density polyethylene (LLDPE) is produced under conditions of low temperature and pr ssure in the presence of a catalyst (a substance that increases the rate of a chemical reaction without being consumed in the process). It has higher melting points and great r stiffness. Tensile strength is 50 to 75% higher than those of conv ntional LDPE. Other prop rties such as impact strength and puncture resistance are also gr ater for LLDPE.

Some of the attributes of LLDPE are its:

- Tear Strength
- Tensile Strength
- Elongation
- Impact Strength
- Higher Seal Temperature
- Hot Tack
- Seals Through Product
- Thermoforms

e. High Density Polyethylene

High density polyethylene (HDPE) has the appearance and sound of paper and is easily printed with bright eye-appealing graphics, thus assuring consumer acceptance. They are much tougher than paper, have greater tear strength, better puncture resistance and higher impact strength. Unlike paper, these excellent properties are realized whether the film is wet or dry. These films offer an even better barrier to moisture vapor, oxygen and other gases than do LDPE films.

The crystallinity of polyethylene determines its density. Increasing crystallinity denotes increasingly uniform and compact alignment of the molecules, thereby increasing the density of the polymer. One of the most important properties alluded to earlier, the film's barrier to liquids and gases, is controlled by density. As the density increases, the resin becomes more resistant to permeation by liquids and gases.

Some of the less desirable properties are its lower machine direction tear strength and more difficult processability. Since HDPE film is much stiffer than LDPE film and has a high yield tensile strength, careful attention to bubble geometry and equipment alignment is necessary in its production. Even slight non-symmetry of the bubble or misalignment of the collapsing frame will result in film with wrinkles.

The wide range of polyethylene in packaging has been enhanced because of the ability of resin producers to "tailor-make" polymers for given film applications. The exact choice of a resin requires specific knowledge of the product to be packaged and what requirements will be necessary.

2. Polypropylene

a. The Manufacturing Process

Polypropylene resins, are manufactured from propylene gas, a by-product of the petroleum industry refining or cracking processes (which are designed primarily to produce gasoline and other petrochemicals).

Polypropylene has the lowest specific gravity (density) of any commercial plastic; thus gauge for gauge, will provide greater yields per unit weight than any other packaging media. Specific gravity is the density of any mat rial divided by that of water at a

standard temperature. Polypropylene is present in a non-crystalline form or a crystalline form. The degree of crystallization and the size of the crystals determine the physical properties of the material.

Polypropylene coatings can be used where the functional properties of grease resistance, higher melting point and abrasion resistance are desired. Polypropylene is extensively used when sparkle, clarity, chemical resistance and stability to change in humidity are desirable features for overwraps and in vertical form/fill/seal or as the "cup stock" web in horizontal form/fill/seal processes for rigid packaging . It is also widely used for fibers and molded articles.

b. Non-Oriented Polypropylene

Non-oriented polypropylene film is supplied in two basic grades: homopolymer and copolymer. The inherent stiffness of the homopolymer material has led to its use where machine performance similar to that required for cellophane is required. Homopolymer film is more brittle at low temperatures and has a narrower heat-sealing range than copolymer film.

Copolymer polypropylene film is heat sealable over a wide temperature range. Since it has machine characteristics similar to polyethylene, it is used in many applications instead of polyethylene. Key polyproplyene film properties for packaging are good scuff-resistance and outstanding optics. High gloss and sparkle, windowpane clarity and non-yellowing and non-brittling characteristics give it visual appeal. Polypropylene film is used where the optical requirements of the application exceed those of polyethylene or where shelf life and economy make it preferable to cellophane. The material also exhibits superior surface hardness and static-free properties to help packages stay factory fresh despite repeated handling.

These characteristics offer advantages for slower moving merchandise or for merchandise displayed on self-service racks or counters. On that basis alone, polypropylene's premium price over polyethylene film may be justified for packages of the presentation of merchandise is the primary consideration.

For uses where the specific properties of oriented polypropylene are not required, non-oriented film can find application because of its lower cost. Non-oriented polypropylene also does not shrink. Polypropylene film prints exceptionally well using the flexographic printing process.

Polypropylene film's greatest growth has been in the soft goods area, especially in the packaging of men's shirts and women's hosiery. Major shirt manufacturers have converted to polypropylene because of the film's shelf life, optical properties (it transmits color without distortion) and the eye-appeal it adds to both package and garment.

Other uses include tapes, twist wrapping of hard candy, bagging of certain vegetables and a wide range of industrial applications utilizing its stretch and sealing capabilities, thermal properties and chemical resistance.

c. Oriented Polypropylene

The term oriented refers to a mechanical straightening and alignment of adjacent polypropylene molecules. The process is effected by two distinct film manufacturing methods: blown and tenter frame.

Through the benefits of orientation, substantial properties are built into the film to make it practical for packaging use even at thicknesses as low as 0.00045 inches. Properties such as moisture barrier, low temperature durability, optical appearance, dimensional stability, flex-crack resistance and grease proofness are all enhanced by orientation. The greater the balance of orientation between the machine and transverse directions, the greater the enhancement of these properties. It should be noted that oriented polypropylene film is not a heat-sealing material as such, but by material modification and by coating techniques, can be made so.

Non-heat sealable films are widely used in combination with other substrates in laminate constructions. This type is usually combined with cellophane, PVDC-coated glassine or PVDC-coated oriented polypropylene film for today's largest application -- vertical form/fill/seal snack food packaging (as in potato chip packaging). Non-heat sealable films are also used in combination with paper for bag liner applications (cookies and pet foods are examples of this application).

Coated heat-sealable oriented polypropylene films can be subdivided into gas barrier or non-gas barrier types. Typical applications of gas barrier type would be snack and candy packaging where excessive oxygen transmission would promote rancidity and/or staling.

3. HIPS

A by-product of the petroleum and natural gas distillation process, styrenic monomer is produced from combining benzene and ethylene gases. Styrene monomer solution, butadiene rubber, plasticizers, antioxidants and lubricants are mass polymerized at temperatures between 100° and 150° C. to produce high impact polystyrene (HIPS) resin.

High impact polystyrene resins are translucent and range in surface from dull to matte to high gloss. HIPS is easily colored with pigments during the extrusion process. Because of its wide processing window, HIPS is among the easiest polymers to extrude and thermoform. The extruded HIPS web is commonly utilized in horizontal form/fill/seal processes as the bottom web or cup stock of the rigid package. HIPS can be sonic welded, spin welded, heat-sealed, solvent bonded, laminated, printed and embossed. HIPS is cost effective and easily recycled.

The heat distortion temperatur of HIPS is 85-90° C. Specializ d grades of HIPS must be utilized where exposure to fats and oils is anticipated, as HIPS is subject to nvironmental stress crack attack. Moisture and gas transmission rates are relativ ly high unless HIPS is coextruded with other materials.

4. Nylon

Nylon belongs to a family of polymers chemically classified as polyamides which, when converted into film, offer a variety of distinctive and useful properties. Such properties include an excellent barrier to oxygen, flavors and aromas, high melting point, abrasion resistance, toughness at low processing temperatures and chemical resistance. Nylon is a moderate oxygen barrier and is very abuse resistant. Because of its abuse resistance, it is almost always specified for structures that are hot-filled, rethermalized and/or shipped frozen. Nylon provides sufficient oxygen barrier for products, such as soups, salad dressings and some edible oils. The ability of nylon to be easily thermoformed and the retention of properties after thermoforming further enhance their usefulness.

Nylon is a frequently used component of Vertical Form Fill and Seal (VFFS) films. Nylon is commonly used with polyethylene or with polyethylene and ethylene vinyl alcohol (EVOH). Nylon cannot form a seal; and therefore, it must be laminated to or coextruded with a sealant like linear low density polyethylene (LLDPE). In some structures, nylon will flank either side of EVOH. As with any expensive ingredient, the smallest amount of EVOH is used in order to minimize costs. Nylon protects EVOH from abrasions that would result in the reduction of its oxygen barrier properties.

The following are some characteristics of nylon film:

- High permeability to moisture vapor and alcohol vapors.
- Low to moderate permeability to oxygen, carbon dioxide and other gases.
- Heat sealable to itself; requires high sealing temperatures.
- Very flexible and formable.
- Very tough film with excellent abrasion and puncture resistance; good resistance to tear; good thermal stability.
- Excellent resistance to grease and oils.
- Good transparency and gloss.
- Tasteless and odorless.
- Moderately high cost.

Nylons are usually designated by a number, which refers to the number of carbon atoms present in each basic unit from which it was formed. By far, the most widely used nylon films are those made from nylon 6 and 66. They can be obtained by a number of extrusion processes and with one or more modifications. Nylon 6 and 66 films are available in both cast non-oriented and oriented forms. With the introduction of uniaxially oriented films, they can now be obtained in three different types -- cast, machine direction oriented and biaxially oriented.

Nylon does not require the addition of a plasticizer or softener. It retains flexibility because it readily absorbs moisture from its surroundings. If it is exposed to a drying atmosphere for sufficient time, this moisture can be lost, and the flexibility and strength of th nylon will be reduced.

Nylon can be utilized where its properties of toughness, excellent durability, extensibility, high temperatur stability and grease resistance are desired. It can be used either as a base material for flexible packaging or as the heat s alant for combinations of other materials.

a. Oriented Nylon

Orientation of nylon film increases the tensile strength, decreases elongation, increases the oxygen barrier properties and significantly reduces thermoformability. When heat set, it has sufficient resistance to heat deformation to permit printing by either the flexographic or rotogravure process and to permit lamination either by dry bonding or extrusion lamination. Oriented nylon also provides excellent puncture and flex-crack resistance.

A more complex structure in which a reverse printed polyester film is laminated to aluminum foil which is laminated to biaxially oriented nylon and then laminated to polyethylene is used for vacuum packaging of coffee. The biaxially oriented nylon is used in this structure for its puncture and flex-crack resistance.

5. Polyester

a. The Manufacturing Process

Polyester film is a plastic material formed by the condensation of certain organic chemicals which produce a polymer containing many ester groups. The resin is extruded by the blown or tenter frame manufacturing process into sheet and film form.

b. Physical Properties

Polyester film is a transparent, highly flexible film, which does not require any plasticizer or softener. A plasticizer, mentioned earlier, is a chemical added to a material to impart either softness or flexibility. Polyester film is internally plasticized by virtue of its structure. It has good moisture resistance, good resistance to solvents and chemical attack and a low degree of permeability to water vapor and gases.

Polyester film usually shows excellent stability and is the strongest of all plastic packaging films with a tensile strength equal to one-third that of steel. It is not affected by changes in moisture, has excellent transparency and can be used over a wide temperature range from frozen food applications to boil-in-bag pouches.

Some of the most desirable properties of polyester film are:

- Excellent optical properties.
- Good printability.
- Good tensile and tear characteristics -- retention und r temperature and humidity extremes.
- Good barrier.

- Exc llent resistance to acids, greases, oils and solvents.
- Exc llent heat stability.
- Excellent dimensional stability.

c. Coated Polyester

Uncoated polyester film is usually not heat sealable. Coating one or both sides can make it sealable, and can also improve handling, barrier or lamination properties. Polyester laminates are used in general food packaging, for liquids and frozen foods, due to the combination of toughness, temperature resistance and non-sensitivity to moisture.

A special one side polymer coated polyester film can be obtained which has been designed specifically for thermoforming. The thermoforming operation imposes a number of stresses on the film. It involves initially heating the film, drawing it into a cavity by vacuum, filling with the product and finally forming into a pouch by sealing it to a second film which has been superimposed over the cavity.

6. PVDC

a. The Manufacturing Process

Polyvinylidene chloride (PVDC) packaging films are made from a copolymer that is predominately polyvinylidene chloride. Sometimes sold under the brand name "Saran."® It is manufactured by a blown film process in which it is extruded, water-quenched for supercooling, blown (to draw it to size, crystallize and orient it), then slit and wound. All PVDC films for printing or lamination are wound on metal cores to ensure film flatness.

b. Physical Properties

Due to the very high chlorine content of the PVDC, this film is highly crystalline and has extremely high barriers to passage of oxygen and other gases, water vapor, odors, aromas and flavors. It has good resistance to greases, oils and solvents and is also resistant to many chemicals that might attack other packaging films. Unfortunately, PVDC cannot withstand temperatures above 180° F. (80° C.) without delamination or separation of film layers. Due to the temperature restrictions on PVDC, a structure containing PVDC cannot be hot-filled or boiled.

PVDC is available as a self-sustaining film which has been extruded and then "oriented" or as a coating applied from solvents or from an emulsion. The films have the property of shrinking when exposed to higher temperatures. This characteristic is frequently utilized for shrink packaging of various food products.

Th gen ral charact ristics of PVDC film are as follows:

- Low to moderate water vapor permeability.
- Low permeability for oxygen and other gases.
- Excellent heat sealability to itself.
- Excellent flexibility and formability if properly formulated.
- Tough, tear-resistant film with retention of properties over a wide range of temperatures.
- Good chemical resistance to most materials.
- Excellent grease resistance.
- Sometimes has a characteristic odor, which could be objectionable.
- Low to moderate cost.

PVDC film is generally used in combination with other materials to obtain good machineability.

Because these films have high cling and gloss, they are used in tight wrap cheese packaging. Blocks of cheese are cured in the film and consumer pieces are either machine-wrapped or wrapped by hand. It is also widely used in the packaging of processed meats, sausages and hot-fill processed cheese. High barrier and chemical resistance make this package ideal for introductory samples, medicines, lubricants, food colors and in-pack food additives. PVDC films can be both flexographically and rotogravure printed.

7. Aluminum Foil

a. General Information

Aluminum foil is a very thin sheet of metal. It remains the best barrier to water vapor and gas transmission available for flexible packaging materials. It also provides a total barrier to light.

In the gauges economically feasible for flexible packaging, aluminum foil is not sufficiently strong to be used by itself. It is, however, easy to laminate to other substrates that provide the strength and bulk that is required. Aluminum foil is not heat sealable; consequently, there is always a need to apply a heat sealing material to the foil surface.

b. Physical Properties

Aluminum foil is not sensitive to moisture and has zero permeability to water vapor and gases if it does not contain breaks or holes. In thin gauges, pinholes are sometimes found in the foil. The rate at which vapor or gas will go through is dependent on size and combined areas of the pinholes present. The number of pinholes is actually quite small, but the number does increase with a decrease in thickness. Pinholes may occur randomly from oxid s or dust particl s in the metal or from stress fractures caused by overflexing the mat rial during forming or handling the finished product. The rate at which vapor or gas will go through is dependent on siz and combined areas of the pinholes present becaus aluminum foil is totally impermeable.

The plastics, paper, adhesives, etc. used for combining with aluminum foils may have und sirable effects. The wrong type and weight of paper may have an adv rse effect. In general, heavier weights of paper and papers with greater stiffness may cause more fracturing of the foil. The more flexible the laminant, coating and strength layers, the better the final result in the barrier property of the foil.

In addition to barrier properties, aluminum foil offers other useful features. Foil, for instance, is printable, highly reflective to light and embossable. The use of transparent inks through which the foil shows, produces pleasing, metallic colors with no loss in brightness or sparkle. Embossing may be used to achieve further decorative effects. The reflectivity of foil is not harmed by aging.

Consumers have used aluminum foil in their homes for a number of years and associate its use with quality and freshness of foods.

8. Cellophane

a. The Manufacturing Process

Cellophane is a natural wood fiber product. It is a highly refined cellulose material that is typically coated with either polyvinylidene chloride (PVDC) or nitrocellulose for use in packaging applications. The use of cellophane in packaging is well past its peak, as more economical film alternatives have been developed. However, there are still particular applications in which cellophane is well-suited or even required. The manufacture of cellophane begins with a special high grade wood pulp. The pulp is shredded, treated with caustic soda to form alkali cellulose and then aged to obtain a controlled molecular weight. The alkali cellulose is treated with carbon disulfide to form a thick, syrupy solution called viscose.

The gases are taken out of the carefully ripened viscose, and it is filtered and piped into a casting machine that extrudes the viscose into a bath of sulfuric acid. The acid coagulates and decomposes the viscose to regenerate a cellulose gel. The translucent cellulose is then processed through a series of baths, where it is washed, purified and bleached and where softening materials are added. Also during this stage, chemicals are added to provide desired end-use properties to the film. The sheet is then dried as it passes over heated rollers and is wound into large rolls. Later, it may be coated to provide desired properties.

Today, about 30 types of cellophane are used, each made with properties to match product and processing requirements.

b. Physical Properties

Not only does cellophane heat seal quickly and without distortion, it offers a wide heat-seal temperature range, and is an excellent barrier to gas, moisture and aroma. It offers excellent machineability, especially on high speed equipment. Its moisture cont nt

contributes to its exceptionally low electrostatic level, which helps prevent static cling to machine parts. With state-of-the-art coating and lamination technologies, cellophane and structures containing cellophane can be virtually tailor-made for the application. Finally, cellophane has outstanding merchandising appeal. It offers a good printing surface with excellent clarity and gloss.

The disadvantage of cellophane is its cost. This is the result of the significant material and energy costs involved in highly refining the wood fibers in the pulping, viscose and film casting operations. The other major drawback in cellophane film is its durability. The film can crack, particularly when dried out as a result of cold weather. However, this effect is a matter of degree, and in any given application may be quite suitable for the end user's need.

c. Uncoated Cellophane

Although cellophane is a strong packaging film by itself, the uncoated form is typically limited to specialty applications -- as a release sheet in molds, as a membrane in batteries or in making pressure-sensitive tape. When dry, uncoated cellophane is a good barrier to gases, but when moist, it offers little resistance to their passage.

Cellophane characteristics may be improved, however, through various technologies, such as coatings and laminations.

d. Coated Cellophane

About 95% of today's cellophane is coated. Cellophane coatings depend on the requirements of the end-use product.

Nitrocellulose-Coated Cellophane. Nitrocellulose-coated cellophane films are generally the least expensive of the coated varieties. They offer significant moisture-barrier properties that can be tailor-made to specific applications. These also machine and seal well and provide good flavor and aroma protection.

Nitrocellulose-coated films are available in two types -- heat sealable (MS) and solvent sealable (M). Heat sealable types are often used in packaging baked goods, frozen, wet or moist products or as carton overwraps. The solvent sealable films are more applicable to twist-wrapped candies and cigarette packages. Nitrocellulose coatings, however, do not have good oil and grease resistance.

PVDC-Coated Cellophane. The cellophanes most used in multi-layer flexible packaging are coated on both sides with polyvinylidene chloride (PVDC) which provides moisture and oxygen barrier and heat sealability. These are considered "premium grades" and are used in applications that call for outstanding appearance as well as high gas and moisture barriers. Typical applications include products that require protection from moisture or oxygen such as potato chips, snack foods, baked goods.

Cellophane is also used in laminations and extrusion-coated structures. It can be us d as the middl layer or multi-ply laminations requiring exceptional coating adherence, for liners in snack food and cracker packag s, and for packaging on high-speed equipment.

9. Paper

a. Manufacturing Process

Paper is a material produced from natural cellulose fibers found in the trees of the world's forests. Cellulose is one of the few polymers not softened by heat. The manufacturing process of paper begins by taking the wood apart and subsequently rejoining the fibers, without their natural binding materials, as an engineered matrix designed to perform an intended end use.

The conversion of wood into paper is an energy-intensive process. However, the process provides a significant part of its own fuel. Many companies also use forest waste residuals, bark and other low quality fibers as sources of energy.

Special properties are derived from subjecting paper to specific processes. To achieve specific end product requirements, surface additives, such as grease-resistant materials or water-repellent materials, may be applied at one end of the process. The most common surface additive on printing grades is starch, which tends to seal the surface of the paper and provides increased surface strength.

While most of the world's paper is made from virgin pulp, some companies also produce recycled paper -- paper made primarily from fiber that was once a carton or a piece of writing paper or newsprint that has been returned to the paper making cycle. Although there are some limitations on recycled fiber, depending on its end use and source, it has a definite role.

b. Bleached Packaging Papers

Bleached fiber may be used to produce bags or converted products where both appearance and containment are important. Bleached MF (machine finish) or MG (machine glazed) papers may be used to produce a variety of bags or wrapping papers for bakery products, fast food chains, department stores and similar applications. Machine finish paper is the normal finish described earlier. Machine glazed finish is obtained by processing the partially dried sheet against a glossy hot surface (a Yankee dryer) where it is dried while in contact with that surface. A smooth, glazed finish results, which provides an excellent uncoated printing surface.

Although labels are made from many grades of paper, label paper is a particular form of bleached paper. The paper is coated on one side with a coating of binder materials and clay. The coating fills in the rough cavities normally found on a paper surface and helps keep ink on the surface during printing operations for a brighter, more attractive finish.

c. Pouch Papers

Pouch papers are special papers usually made from bl ached fibers. Th y are manufactured in such a way as to be very smooth, pliable and opaque. Fr quently used for food packaging, they lend themselves well to printing and laminating. They are

usually laminated to foil, glassine, polyethylene or other papers. By means of laminating or coating, barrier properties can be imparted to these materials.

d. Glassine Paper

Glassine and grease proof papers are specialized papers used mostly for food packaging. Earlier, the refining of fibers was discussed. When producing glassine, individual fibers are excessively refined (by mechanical beating) to the extent that a high degree of fiber damage and collapse is achieved until the pulp appears to be an almost gelatinous mass. The higher degree of fiber collapse and increased bonded area makes the subsequently manufactured paper very resistant to grease or oil penetration. With additional treatment, barriers to odor or moisture can be achieved.

e. Parchment Paper

Parchment paper, like glassine paper, is produced from cellulose fibers which have been formed into a gelatinous mass. With parchment, however, this transformation is brought about chemically by treatment with sulfuric acid. Parchment is particularly noteworthy for its excellent wet strength properties.

f. Waxed Paper

Waxed paper may be produced from a variety of substrates, but generally the base sheet is refined more than normal paper. The product is wet waxed when the wax remains on the surface, and dry-waxed when the wax impregnates the sheet without any surface wax. Because it is tasteless, odorless, non-toxic and inert, it is widely used for food packaging applications.

g. Comparison of Paper Types

Almost any of the broad spectrum of papers can be used in structures, which permits the choices to be made based on strength, packaging machine function, graphics or aesthetics and economic considerations. Where the product contains ingredients, such as shortenings or fats, the papers can be treated to resist staining. Where the product is hard and tends to puncture packaging materials, special bleached kraft papers designed for good puncture resistance are used.

The tissues, pouch papers and MG bleached kraft papers, when used as the external component of the pouch, are generally printed either flexographically or by rotogravure using line printing. The clay coated papers are used where vignettes showing product illustrations are used and are printed by either process rotogravure or process flexo.

Clay coated papers provide the ultimate printing surface where multicolor process printing is required to provide high quality pictorials. These papers can then be laminated to a wide number of different films or foils to produce the finished packaging material.

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CHAPTER 4

PRE-FORMED CUPS & TRAYS

This chapter provides general information on pre-formed cups and trays.

A. GENERAL INFORMATION

Cup trays can be produced out of many different materials and gauges. Initially, materials used are restricted by:

- The ability of the filling equipment to cut the material
- The availability of lidding film that will properly seal against the cup material used

When choosing materials appropriate for a specific product, always remember that vinegar and polystyrene are not compatible. When packing vinegar-based products, some type of barrier material is required. Cup capacities vary as a result of product viscosity along with required head space. Creating "new" cup capacities per tray series is not difficult, but is usually dictated by tolerances on the filling equipment.

B. MOST COMMON MATERIALS USED

- High Impact Polystyrene (HIPS)
- High Impact Polystyrene/ Polyvinylidene Chloride Coated (HIPS/PVDC)
- Polyvinyl Chloride (PVC)
- Compounded Polypropylene

C. MATERIAL CHARACTERISTICS AND USE CONSIDERATIONS

(1) High Impact Polystyrene

- Low Cost
- Variety of Colors
- Poor Barrier
- Fair Impact Strength
- Mainly Used for Jams and Jellies
- Should Not be Used with Vinegar-Based Products
- Low Cost

(2) High Impact Polystyrene/ Polyvinylidene Chloride Coated

- Higher Cost
- Variety of Colors
- Excellent Barrier
- Increased Shelf Life
- Fair Impact Strength
- Mainly Used for Sauces and Dressings

(3) Polyvinyl Chloride

- Higher Cost
- Clear or White
- Excellent Barrier
- Good Impact Strength
- Mainly Used for Jams and Jellies, Sauces and Dressings
- Good Impact Strength

(4) Compounded Polypropylene

- Highest Cost
- Microwaveable
- Limited Colors
- Excellent Barrier
- Excellent Impact Strength
- Mainly Used for Sauces

CHAPTER 5

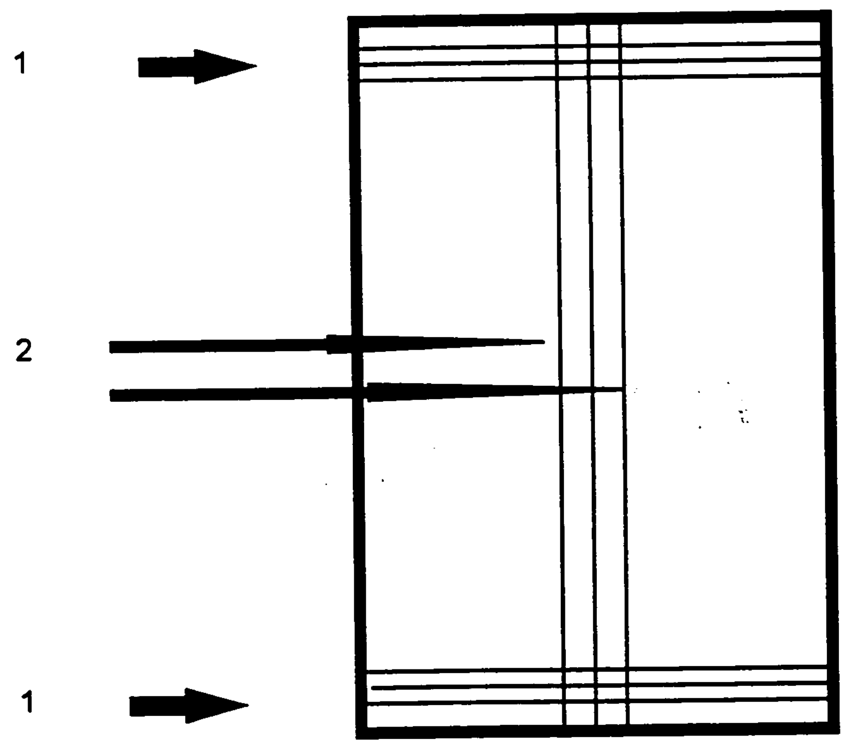
SEALS

This chapter provides general information on seals.

A. INTRODUCTION

Having determined which material characteristics best protect the product, the film-packaging equipment compatibility must be examined. The main information ne ded is the type of horizontal and vertical seal (see Figure 5-1) that is made by the equipment. A seal is made by the combination of three items: time, temperature and pressure. Since Vertical Form Fill and Seal (VFFS) packages are made with automated pieces of equipment, the maximum temperature and pressure that the film and equipment can withstand is used, thereby minimizing the time needed to make the seal. Two types of sealing mechanisms exist - impulse and continuous. The names are descriptive of their functions.

Figure 5-1 - Back View of a VFFS Package with Multi-rib Horizontal Seal and Lap Vertical Seal



KEY

1 - Horizontal Seal
2 - Vertical Seal

B. IMPULSE AND CONTINUOUS SEALS

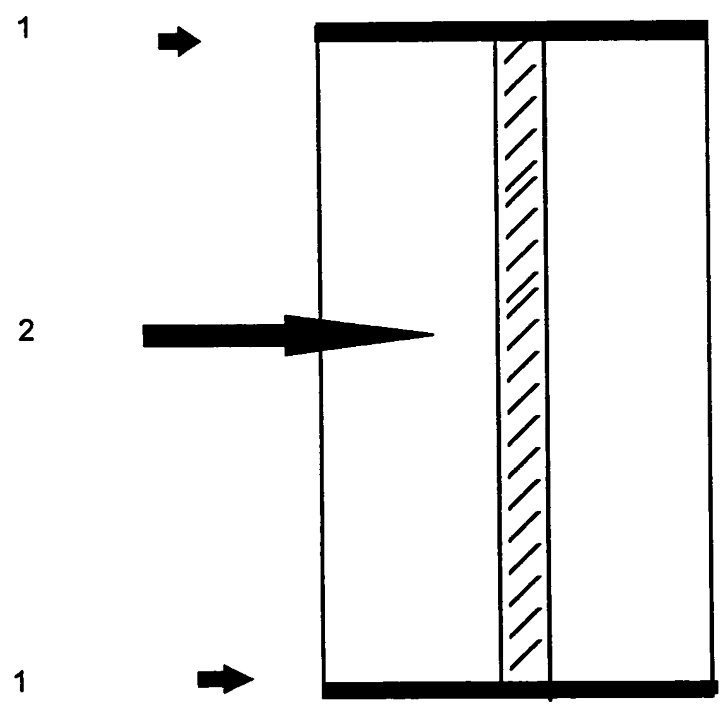
An impulse seal sends electricity to a seal bar, heats the seal bar momentarily and seals the package or film. A continuous seal is continually heated. On VFFS equipment, generally the impulse seal is used for films that are easy to seal, such as a linear low density polyethylene (LLDPE) structure or an LLDPE/polyvinylidene chloride (PVDC) structure. A continuous seal is used for films that require more heat to pass through the layers to produce an adequate seal. Such structures may contain LLDPE as well as nylon or nylon and ethylene vinyl alcohol (EVOH). For an impulse sealer to reach a sufficiently high temperature to seal through nylon and EVOH, it would require a longer period of time compared to a continuous heater that is already at the appropriate temperature. An impulse sealer will seal through materials such as nylon and EVOH, but it will take longer and sacrifice output speed.

C. VERTICAL SEALS

Fin Seal

The vertical seal is usually made by a continuous heat seal and may be a fin seal or a lap seal (see Figure 5-2). In a fin seal, the inside right edge of the film is sealed to the inside left edge of the film (see Figure 5-3). The fin seal does not typically lie flat. The fin seal sticks up much like a fin of a fish and is commonly used on a potato chip bag. A Hayssen Ultima makes a package with a fin seal.

Figure 5-2 - Back View of a VFFS Package with Impulse Horizontal Seal and Fin Vertical Seal



KEY

1 - Horizontal Seal
2 - Vertical Seal

Figure 5-3 - Fin Seal

Lap Seal

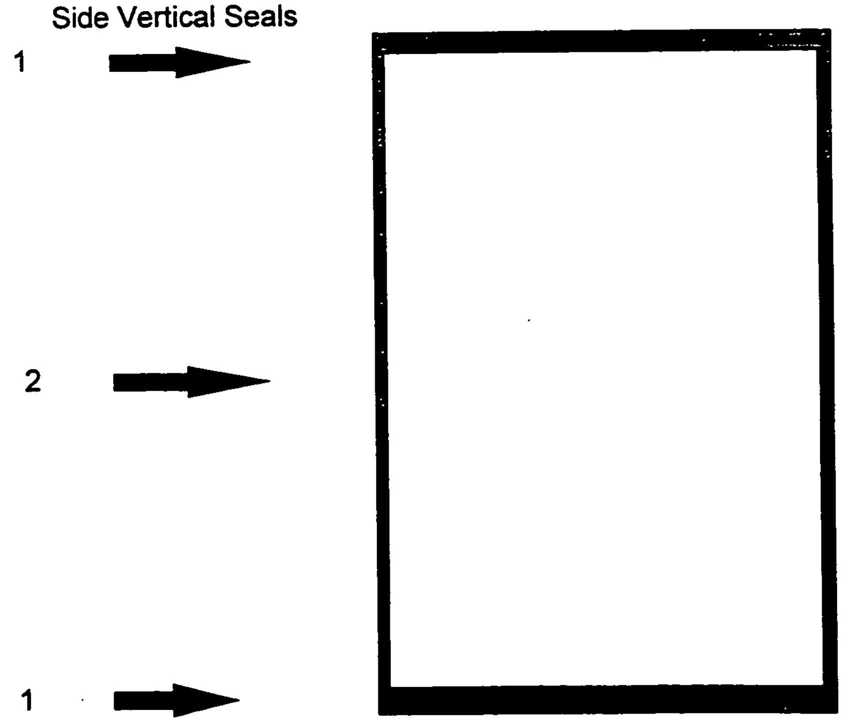
A lap seal seals the inside right film edge onto the outside left film edge, or vice versa (see Figure 5-4). A lap seal is able to lie flat. The Onpack and Prepac series of equipment make lap seals.

Figure 5-4 - Lap Seal

Side Seals

Some VFFS equipment does not have a fin or lap seal -- it has side seals (see Figure 5-5). Typically, two rolls of film meet, sealing the inside of one roll edge to the inside of the other roll edge. The resulting package has seals on all four sides and resembles a pouch. A Lane L-18 makes packages with four seals. A more economical package has seals on three sides only. A Lane LD-32 makes these packages using one roll of film and folding the film into pairs of channels (see Figure 5-6).

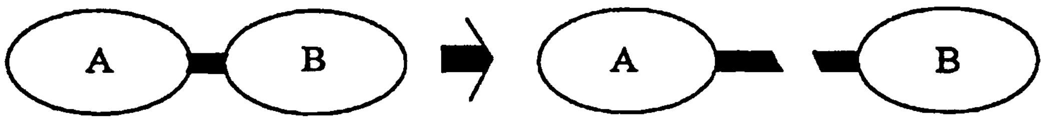
Figure 5-5 - Back View of a VFFS Package with Continuous Horizontal Seals and Side Vertical Seals



KEY

1 - Horizontal Seal
2 - Vertical Seal

Figure 5-6 - Formation of Channel Pairs



D. HORIZONTAL SEALS

The horizontal seal (or end seal) can be made by an impulse or a continuous heat sealer, depending on the equipment. An impulse seal makes a thin beaded seal, such as that on the Prepac or Hayssen. The Lane L-18 and LD-32 has a continuous heat seal that forms an end seal that is in excess of approximately 0.25 inch in width. Some end seals are made of alternate thin seals and void areas. When the seal jaws close, the sealed area forces particulate, such as spices or steam, into the void area. Consequently, the integrity of the seal is not breached. In the case of hard to seal items such as tomato paste or meat, if the product prohibits one seal from forming, up to four other seals are intact.

CHAPTER 6

PRINTING

This chapter focuses on the various printing methods in use for flexible and rigid packaging.

A. PROCESS SELECTION

Printing can be functional or decorative or both. In either case, it adds eye appeal and makes the product more marketable. There are several printing methods in use, including flexography, rotogravure, lithography and letterpress.

When selecting a printing method, consideration must be given to several factors, including:

- The substrate and its form
- The design
- Quantity of the run
- Costs

The material being printed can be a deciding element in selecting the proper method. Flexible films, typically, are printed using flexography, rotogravure and, in some cases, offset lithography and modified letterpress. Most flexible films require some form of treatment to increase adhesion and, under certain conditions, need special ink formulations. Characteristics of some of the special inks eliminate one or more printing methods.

The design involved is also critical. In the case of a flexible film, flexography and rotogravure should be given consideration. Rotogravure will produce the better quality, but may be cost prohibitive if a low volume run is involved.

Additional consideration must be given to the length of the run. Plate costs, "make ready" and the frequency of the job directly affect the unit cost.

All the factors involved in selecting a method affect costs. Printing a low-quality, short-run job by rotogravure would increase the unit cost such that it would be prohibitive. The objective is to produce an acceptable job at an acceptable cost. Often costs can be lowered by combining printing methods to take advantage of the best of each. Each process will now be discussed in greater detail.

B. FLEXOGRAPHY

Flexography (or "Flexo") is the most widely used printing process for flexible packaging. It is a letterpress technique; however, unlike letterpress, flexography uses plates made of rubber or photopolymers, which make the use of liquid inks possible. The plates are flexible or are made curved to adjust to the plate cylinder of the press. The printing is accomplished by a transfer of ink from the raised surface of the printing plate to the material being printed (see Figure 6-1).

Figure 6-1 - Flexographic Plate

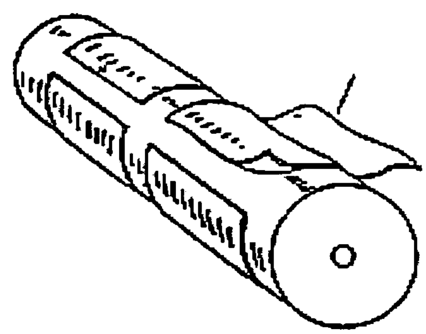
Inks used for flexography are liquid or low viscosity and are fast drying. Ink is metered from the fountain to the plate either by a two-roll or doctor blade system. The two-roll system consists of an etched or knurled anilox cylinder (form roller) and a rubber roller. The rubber roller acts as an inking device when in contact with the anilox cylinder, which meters a uniform film of ink onto the printing plate. In the second system, the doctor blade wipes the anilox cylinder (similar to rotogravure) and in so doing controls the amount of ink that is applied to the plate.

You can recognize flexographic printing with a magnifying glass by detecting a slight squeeze out of ink on the edges of an otherwise solid ink film.

The process of flexographic printing with the doctor blade or two roll system is as follows:

- A plastic mold made from a metal or photo engraving process.
- The rubber plates are then made from the plastic mold.
- The rubber plates are mounted onto a steel cylinder by means of an adhesive backing material (see Figure 6-2).

Figure 6-2 - Flexo Cylinder



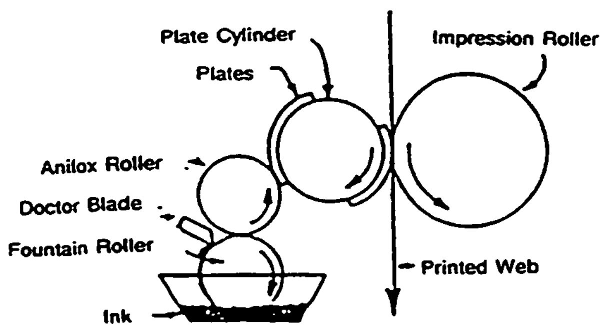
Photopolymer - laser engraved rubber plates can also be used in the flexographic printing process.

To print:

- A rubber roll rotates in a fountain of ink (see Figure 6-3).
- The rubber roll transfers the ink to an anilox (engraved steel) cylinder.
- For process printing and printing fine type, a doctor blade presses against the anilox roll to remove excess ink.
- The anilox roll then transfers the ink onto the raised printing surface of the plate.
- The ink is then transferred to the web. The amount of ink applied is controlled by adjusting the relationship between the rubber roll, the anilox roll, the doctor blade and the plate cylinder.

Each color is applied from separate stations or decks.

Figure 6-3 - Flexographic Printing Process



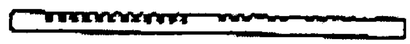
Advantages and Disadvantages

Flexography is best suited for short and medium runs as plate costs are relatively low and less time is needed for "make ready". Print quality, specifically in tone or process work, is not as good as would be expected with rotogravure. However, advance in plate material, ink formulation and anilox roller design have resulted in significant quality improvements.

C. ROTOGRAVURE

Rotogravure (also called "gravure") is an "itaglio" system, in that the printing areas are below the surface of the plate (see Figure 6-4). Rotogravure is similar to the flexographic printing process with the exception that the print is applied by a hard, metal cylinder which has been engraved with the desired graphics pattern.

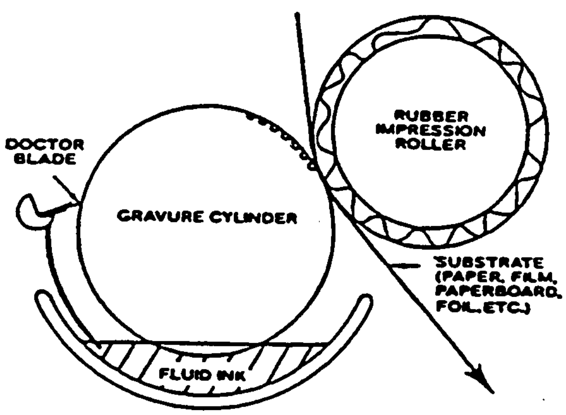
Figure 6-4 - Rotogravure Plate



The process of gravure printing is as follows:

- An engraved cylinder is prepared by etching the image area into a copper cylinder. The surface is then chrome-plated to protect the copper against wear and corrosion. The depressed areas are the printing areas and the surface represents the non-printing areas (see Figure 6-5).
- The cylinder rotates in an ink bath.
- The excess ink is wiped off by a doctor blade, leaving ink only in the depressed areas.
- The ink in the recessed cells forms the image by direct transfer to the printing surface as it passes between the cylinder and impression roll.

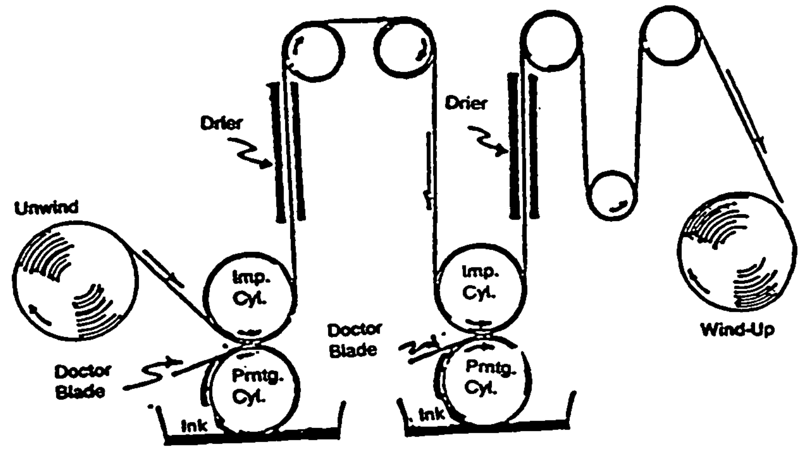
Figure 6-5 - Gravure Printing Process



Each color making up the graphic pattern requires the use of its own gravure cylinder. Thus, rotogravure printing is a very expensive operation. It is primarily used for large and/or repetitive orders - the longer the run length, the less expensive the operation becomes for each unit produced.

Generally, inks used are low viscosity liquids and contain volatile solvents, which allow for rapid drying. Each color is applied from a separate cylinder and is dried before additional colors are applied (see Figure 6-6). This is accomplished by a series of printing units and dryers in tandem.

Figure 6-6 - Separate Color Application in the Gravure Printing Process



You can recognize rotogravure printing with a magnifying glass by detecting either the diamond-shaped cells or the cell effect on small type. In solid areas, the ink from the cells will flow together and form a solid flat ink film; the edges, however, will show a jagged line, not visible to the naked eye.

Advantages and Disadvantages

Each time copy changes, a new cylinder must be manufactured. Since the cost of preparing cylinders is very high, rotogravure is usually used for long runs and/or where copy changes will be fairly infrequent. Sometimes, gravure printing must be used to achieve the required quality of reproducing fine tone and process work.

Advantages are high-quality tone and process reproduction. Rotogravure gives excellent image reproduction and high resolution, so it is useful when the design requires precision printing. In general, the quality of the printed image is superior to flexography. A skilled flexographic printer can get very close, however. Additionally, rotogravure is also used exclusively to apply the patterned cold-seal cohesive to the back-side of the web. It allows greater and more specific control over the coating weight, resulting in more dependable and consistent bond strength performance.

The disadvantages of rotogravure are that it can leave a serrated edge look to the printed copy and cylinder wear from the doctor blade can shorten the useful life of each cylinder, thereby adding to the overall cost. Cylinders must be handled very carefully to prevent damage to the engraved cells. Even a small nick in the surface requires that the cylinder be re-engraved, at a high cost.

D. LITHOGRAPHY

Lithography is also referred to as "offset lithography" because the printing plate first prints on a rubber blanket which, in turn, prints directly to the paper. Lithography is not used as extensively for plastics as are the other printing processes.

The ink used is a viscous paste and is carried from the fountain through several distribution rollers to the plate (see Figure 6-7). The plate is planographic, having the image area treated to accept the ink and the non-printing areas treated to repel the ink (see Figure 6-8). A solution of water and/or alcohol and other additives are also applied to the printing plate along with the ink. The incompatibility of this solution with the ink is a factor in the selective inking of the image areas of the plate. As a result, only the image is transferred to the blanket, and subsequently, to the substrate.

Figure 6-7 - Lithographic Process

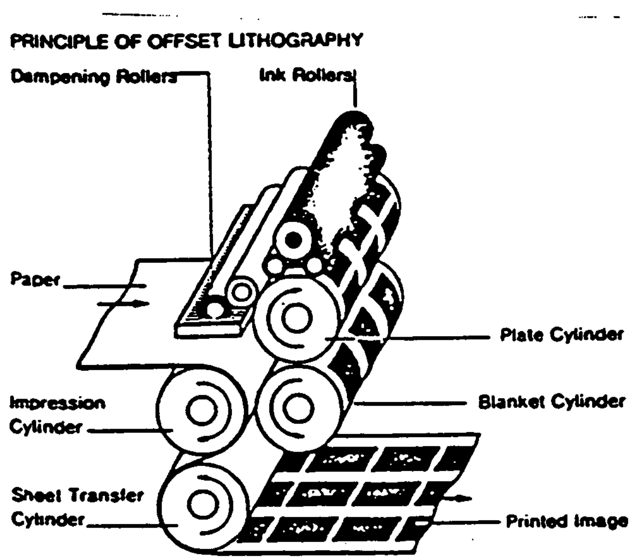


Figure 6-8 - Lithographic Plate

Advantages and Disadvantages

This method produces good quality process work, the result of the thin film of ink that is applied and the accuracy of control. Plate costs are relatively low which makes it useful for short runs. Pr sses are available to print w b and sheet. This method is limit d to substrat s that are adaptable to these conditions.

E. COMPARISON OF LITHOGRAPHY, ROTOGRAVURE AND FLEXOGRAPHY

Listed below is a comparison chart of the three most commonly used printing processes today.

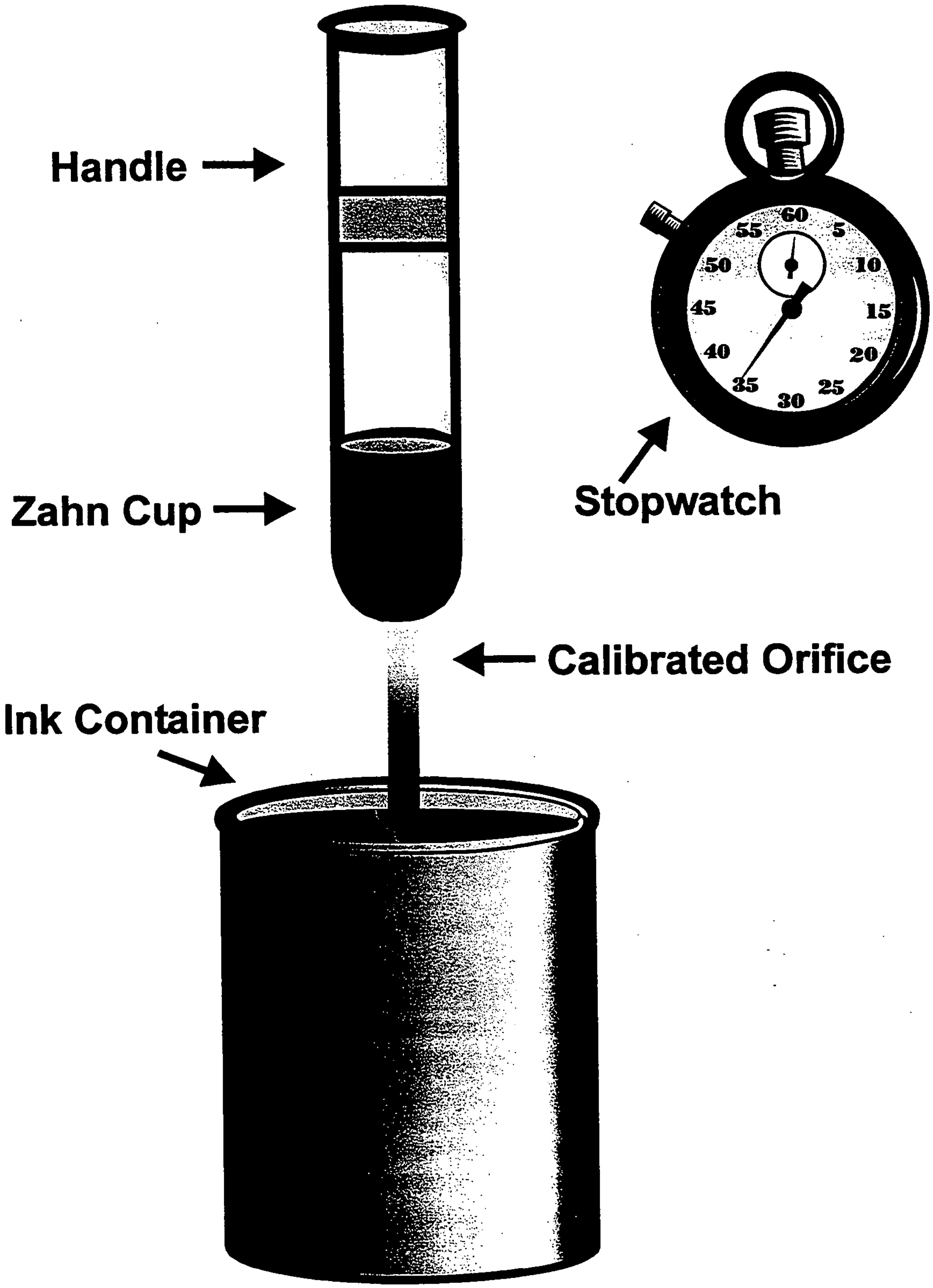
	Litho	**Roto**	**Flexo**
MAKE READY:	On-press	Off-press	Off-press
REGISTER:	Good	Good	Good
PRESS TYPE:	Sheet/Web fed	Web	Web
BEST SUITED FOR:	Short runs	Long runs	Short runs
TONAL GRADATION:	Good	Excellent	Good
INKS:	Paste-type	Fluid	Fluid
PRINTED ON:	Board, Paper	Board, Paper, Some Films	Board, Paper, All Films
PROCESS PRINTING:	Good	Excellent	Good

F. INK AND LACQUER CONSIDERATIONS

Inks used in printing generally have a thin viscosity and can be dried quickly. Viscosity is a measurement of a fluid's ability to flow. A fluid of high viscosity means it is thick and flows slowly, while a low viscosity fluid flows quickly and is thin. During printing, it is critical to maintain the right viscosity in order to achieve just the right amount of ink coverage, which provides a consistent color over the web surface. Viscosity can be measured accurately with a viscosity meter, but is commonly measured using either a Zahn or Shell cup (see Figure 6-9).

With each cup type, a container (mounted to a long handle) holding a specific quantity of ink or other fluid is dipped into the ink container and filled to the brim. The cup has a calibrated orifice drilled into the rounded bottom, allowing the ink to flow out when lifted out of the ink container. The amount of time, in seconds, it takes for the cup to empty (using a stopwatch) is recorded as the viscosity and can be correlated to measurements on a viscosity meter. The meter defines viscosity in units called centipoise. This is a unit of resistance acting on a turning spindle submerged into the ink or fluid. In either case, cup or viscosity meter, the inks and fluids used in manufacturing must be controlled within a specified range of viscosity to give product consistency, quality and cost control.

Figure 6-9 - Taking a Zahn Cup
Viscosity Reading



A lacquer is a nearly clear coating applied over the top surface of the ink. It can perform two distinct functions - (1) determine the gloss or amount of shininess of the product surface; and (2) giv the product a predetermined amount of slip. Slip refers to how slippery the wrapper or bag surface is to both itself and to metal surfaces so that it can glide with ease over, around and through a packaging machine.

Slip is one of many critical quality characteristics to be carefully controlled. Control is obtained by selecting the appropriate lacquer, establishing its correct viscosity and by the volume of lacquer coated on the web surface. Slip can be measured as the coefficient of friction (COF) or the amount of resistance force from dragging a weighted stainless steel "sled," or block, over the web surface. The force required to move the sled at a designated test speed is recorded in grams and is called the kinetic COF. Also recorded is the amount of force, in grams, to overcome the inertia (resistance to change) to start the sled moving and is called the static COF value. This amount of force is typically much higher than the amount of force needed to keep the sled moving across the surface. To measure slip to a metal, stainless steel surface, a piece of web is mounted to the sled itself and dragged across the test instrument's metal platen surface. Thus, four separate test measurements are used to define slip:

1. Film to Film (written as "F/F") - Static and Kinetic
2. Film to Metal (written as "F/M") - Static and Kinetic

Lacquers applied to a product surface determine the final appearance through the use of the characteristic of gloss. A product's surface can be glossy (shiny), have a satin (soft) appearance, or be matte (dull) finished. Lacquers give the visual "depth" and "brightness" to the graphics, making a very appealing package to attract consumers to products and performance that helps to move product to the market quickly.

G. GUIDELINES FOR SPECIFYING TARGET COLORS

The following information provides guidelines in specifying and monitoring colors used on packaging materials.

1. Color Perception

Color is the perceived effect of light waves bouncing off or passing through various objects. The color of a given object is determined by:

- the characteristics of the light source under which it is viewed;
- the way the object absorbs, transmits or reflects the light waves striking it; and
- the characteristics of the receiver, be it the human eye or instrument.

2. Selecting Target Colors

Initial color selection is commonly made from a pantone matching system (PMS) or a G.C.M.I. color book.

This initial choice must be applied on the substrate or laminate to be used to verify its appearance. Example: Pantone colors on a white paper background will look significantly different when applied on a foil substrate.

3. Color Variations in Printing

Several factors contribute to the variation experienced in printing colors including:

- the substrate material
- the printing process itself
- the amount of material to be printed
- gloss
- lamination
- optical brightness
- purity, dispensability and particle size of pigments used
- extent of pigment bronzing

4. Optical Evaluation of Color Variation

In critical situations, it is common for a printer to assist a customer in establishing acceptable color variance standards by providing color "draw downs" that illustrate a standard and a "light" and "dark" extreme. These standards must be kept by both the supplier and customer and must have been created at the same time, from the same ink system that is being used, stored carefully to avoid fading, viewed under the same light source and viewed by qualified observers (not all human eyes interpret color in the same manner) for a valid observation of color control or color comparison.

5. Instrumental Evaluation of Color Variation

Instruments have been developed in an effort to translate color concept to numbers.

The CIE (Commission Internationale de L'Eclariage) Color System is a recognized international method for measuring, designing and matching colors. In the CIE system, three theoretical primary colors (red, blue and green) are instrumentally determined by a spectrophotometer for the evaluated color. These three values are then mathematically plotted on a chromatical diagram as a chromatical point. The relative percentage contributed from each of the three values are used to determine a tristimulus value for the color measurement.

It has been recommended that the CIE Color System, using a specified light source, be us d as an objectiv techniqu for valuating target colors. Acceptable color variance must be agreed upon between the printer and customer. For the most reliable results,

both printer and customer should monitor color using the same equipment, the same illuminant, the same resolution and the same CIE standard observer tables.

A color spectrophotometer also reads and defines colors according to three dimensional scales. This instrument is often used to specify colors or as a quality assurance check.

Conclusion

Whether human eye or instrument is used to perceive color, the critical elements in discussing color control are that both the printer and customer have agreed upon established color variable standards, and are looking at identical samples under the same illuminants that are being monitored by receivers that operate by the same parameters.

H. MAKING A FINISHED ROLL OF FLEXOGRAPHIC PRINTED FILM

To further understand the process of making a roll of printed film that is ready to ship to the customer, the following individual steps and processes will be needed. For this example, the central impression (CI) press will be used.

1. Make-Ready

At this stage, the preparations for a press run are in progress. Previously, the flexible printing plates were molded and mounted to a cylinder. Current technology uses lasers to cut the image into rubber-coated cylinders or sleeves. Proper cylinder gearing is established to register each color to the next when the cylinders turn, inks are prepared for the proper color match and quantity, and all materials (web substrates, adhesive and/or cohesive) are assembled together and staged at the respective work station. A quickly done and efficiently completed make-ready significantly contributes to maintaining a productive and profitable work schedule for each press.

2. Printing

This stage is directly dependent on the color match of the ink, its viscosity, proper printing plate mounting and the selection of the correct anilox roller to apply an optimum amount of ink at each printing station. Other related factors include how much pressure the printing plates apply to the web for good ink transfer without distorting the printed image, the tension of the web held in the press and the ability to dry the ink adequately. Success of the printing is also dependent on how well one color is registered to the others, and how uniform the ink coverage is without streaks, blemishes or other defects. Laser-cut printing cylinders have greatly enhanced the accuracy and quality of the flexographic printing process, while eliminating the printing "breaks" between mounted printing plates.

3. Ink Drying

After each printing deck or station, the ink is flash dried just enough so other colors can be added to the web without smearing or running together. The ink solvents are highly volatile, meaning that they evaporate very quickly to leave the vehicle (resin) and pigment of the ink behind as a coating on the web that are seen as the printed graphics. The dryers that do this are called the "in-between" color dryers. Once all the colors are applied, the web moves through an oven tunnel to complete the drying process.

4. Laminating

Laminating produces a very strong, high performance structure by bonding a secondary web to the first. An adhesive is applied by rotogravure across the entire web and dried in a tunnel dryer along the web path. After it is dried and cured to give the necessary adhesion performance, the secondary web is pressed onto the adhesive by a laminating roller. This class of adhesives are called pressure-sensitive adhesives because they require pressure to achieve maximum bond strength to the substrate applied to them. The process of curing will be discussed in a later section.

5. Sealant Coating

Sealants, whether of the hot melt or cohesive type, are applied by rotogravure methods. This minimizes the amount of coating applied to the web while maintaining desired bond performance characteristics. A hot melt can be coated across the entire web since it would not transfer to the wrapped food product. It needs heat and pressure to be activated - not encountered in normal handling or storage. A cohesive is active at all times; therefore, it is coated in a pattern around the perimeter of the wrapper and does not usually come into contact with the food item, although it is safe for consumption. Contact with anything when exposed would disrupt the cohesive layer due to its active nature. The wrapper sealing process uses up all the available, exposed cohesive surfaces. Another benefit to using cold-seal in a pattern is that only enough to perform the job is used, which controls internal costs.

6. Sealant Drying and Curing

Not only does the sealant (or adhesive) need to be dried, it has to be at the correct state of cure. Cure is a chemical process where the smaller chains of molecules, while in the liquid phase, link together to form long chains in the dried phase. Performance is determined by the length of the chains and how many of them have formed. Adhesives and cohesives require that some small chains remain, meaning that the material does not become fully cured. This results in the soft tackiness, or adhesive grip, needed to mount it to a surface (adhesive) or to itself (cohesive). If allowed to fully cure, it becomes crystallized (glass-like) and will not bond to anything with any strength. Aging of the material causes a loss of performance because the curing process never stops - it eventually becomes crystallized. Controlling the amount of cure optimizes the d sired performance over a given amount of tim , thus defining its shelf lif . Curing is initiated by h at and the evaporation of the solvents through drying; so, by controlling the int nsity of the ov n heat, and th tim it is xposed to that h at, we can directly affect the success of using specific adhesive materials through the curing process.

7. Winding/Unwinding/Splicing/Roll Changing

These factors control the movement of the web through the press. Materials are unwound while they feed through the press and they are wound up once the value-added processes are completed. In the meantime, as a roll of material has been used up, another must be attached to the first to continue the run - and it must be done without shutting the machine off. The process of attaching one roll to another is called splicing. Printing presses can splice rolls together while running at normal speeds. This is referred to as "flying splices." Also done are "flying roll changes" at the windup station. The web is cut from the windup roll and immediately affixed to a cardboard core mounted on a secondary shaft. The run continues while the completed roll is removed from the machine. The speed of the machine results in a splice that can only be defined as crude. The slitters, which are covered later, are used to take out these crude splices and replace them with neat, usable splices when necessary. Flags applied to the roll before and after the splice show the slitter operator where to remove below standard material.

8. Job Change-overs

Once a job is completed, it takes a great deal of effort to get the press up and running with the next job. Material changes are made and ink and adhesive decks must be thoroughly cleaned and changed for new materials being used. Press adjustments and settings must be made and verified, according to the specification. Anilox cylinders may need to be changed as well as installing the print cylinders mounted with the new plates or sleeves. Perhaps, changes are also needed in the path that the web is strung through the machine. Different decks, or work stations of the press, might be used or eliminated from the previous job. To make this occur as efficiently as possible, many preparations are performed before the last job has been finished. This is called the pre-press stage and it attempts to have as much as possible done and ready before the press stops.

I. FINAL FINISHING

1. Slitting

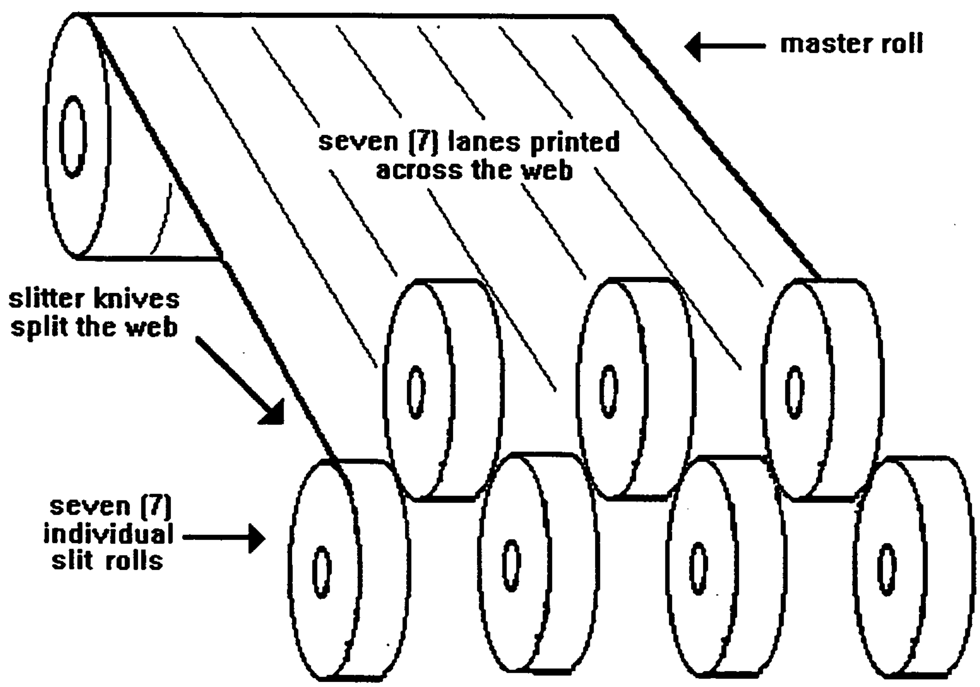
A master roll (or log roll) produced on a flexo press generally consists of a number of individual rolls of printed wrappers. Each of these rolls, while still part of the master roll, is called a lane. These individual rolls need to be separated into rolls of just the right size for the customers to use on their packaging equipment. This is accomplished on a machine called a slitter.

The material is unwound, cut to size (width and length) and rewound into the individual rolls (see Figure 6-10). Excess material cut from the sides of the master roll is called "trim" and is discarded. While the slitting process is underway, setup and non-conforming "below standard" material or other scrap contained in the master roll can be removed. The slitter is stopped, th non-slit web is cut and the bad material is remov d. Only when good material can be unwound from the mast r roll, is the material spliced, or join d together, by butting the dges against on another and

bonding them with a special tape. The web can then continue to be slit with only good material contained in the roll.

Special tapes need to be used which will not cause unnecessary difficulties in using the roll as splices pass through the packaging machines. Also, critical to the quality of the finished roll of product is that close tolerances are maintained on the width of cut, how the graphics and cold-seal areas are positioned and that there is proper roll confirmation; that is, the sides of the roll are straight and smooth. If the roll is dished, with the edges of the outside wraps not in line with the core, the roll is considered to be telescoped and is not usable. The quality of the slitting determines how well the individual slit rolls run on the packaging equipment.

Figure 6-10
THE SLITTING PROCESS



2. Rewinding

Rewinding is usually done to individual rolls of material that have come from the slitter and have one of several problems associated with them. The rewinder machine is, therefore, a rework machine - it takes rolls of non-salable stock and reworks them into salable condition. It can also be used for close examination of the w b wh n looking for d fects or just to unwind a telescoped roll and improv its roll conformation by winding it up again. Rolls can be salvaged that might otherwise be scrapp d.

It is a slow, labor-intensive and somewhat tedious process. However, given the cost of scrapping an entire roll of expensive packaging, it can recover some of the losses due to internal quality-related problems.

3. Shipping

Great care must be taken to ensure that the material will arrive at the location clean and free of contamination. Procedures are in place for properly loading finished rolls of product on to pallets and wrapping them in protective stretch wrap. If requested, samples from the lot are included with the shipment and other packaging and shipping requirements are confirmed. Comprehensive labels are adhered to the wrapping for lot traceability, similar to the labels included in the core of each slit roll. Final checks to verify order quantity and other information are performed. Transportation is arranged and the product delivered.

CHAPTER 7

EASY OPENING FEATURES

This chapter provides information on easy opening features of pouches.

A. TYPES OF EASY OPENING FEATURES

In previous sections, the importance of barrier properties and seals were discussed. Keeping the product in the package is a key consideration. However, at some point, the package will be opened by the consumer. To facilitate the removal of product from the package, a number of easy open features have been incorporated into packages. These features can be as simple as a side tear notch, or small cut, in the horizontal seal area of the pouch. Illustrated below in Figures 7-1, 7-2 and 7-3 are examples of easy open features for pouches.

Figure 7-1 - Side Tear Notch

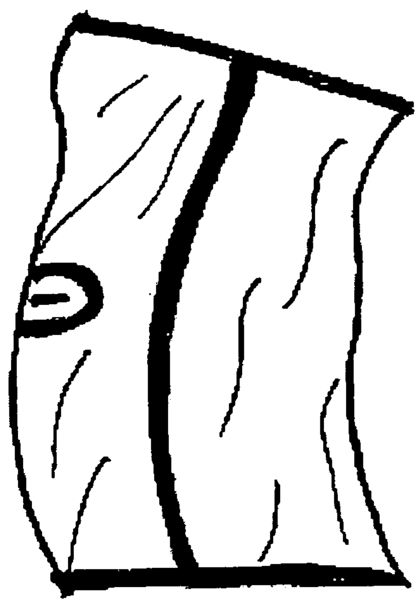


Figure 7-2 - Horizontal Tear Notch

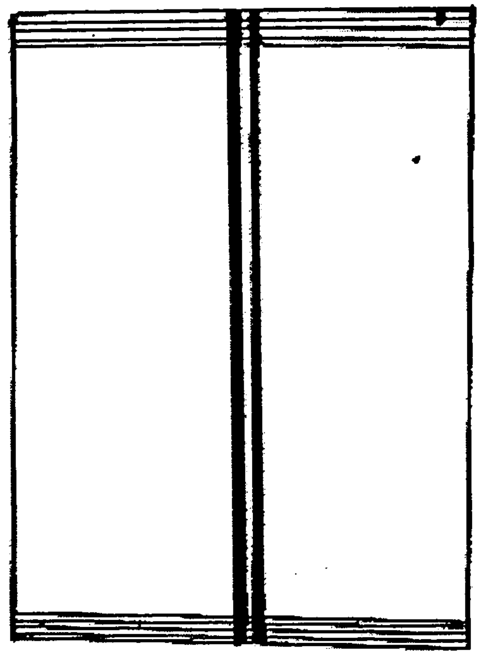
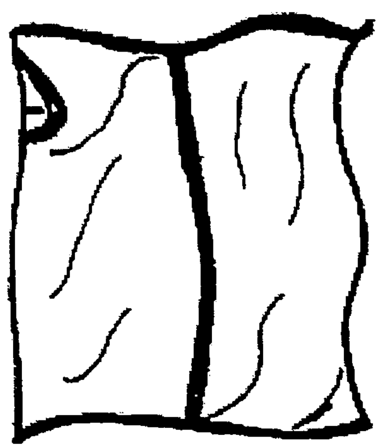


Figure 7-3 - Angle Side Tear Notch



B. FILM TYPE CONSIDERATIONS FOR EASY OPENING FEATURES

If opening is a key consideration, thought must be given to the film type. Biaxially oriented structures, such as ethylene vinyl alcohol (EVOH), have good tear propagation. Nylons that have not been exposed to heat have better tear propagation than those that have been hot-filled or rethermalized. Films that are stretchy in nature, such as a polyethylene or a polyethylene and polyvinylidene chloride (PVDC), generally provide poor ease of op nability. If resealability is important, zipper-lock features may also b incorporated.

CHAPTER 8

TESTING METHODS

This chapter includes information on testing methods for portion control and flexible packages. A brief discussion of record keeping is also included.

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A. A NOTE ON RECORD KEEPING

When producing product for human consumption, it is critical that appropriate quality assurance tests are in place as well as documentation of the test results to certify the food as safe. Many plants are implementing a Hazard Analysis and Critical Control Point (HACCP) plan, which is an overall approach to food safety. A HACCP plan goes beyond Good Manufacturing Practices by flow charting the manufacturing process and identifying potential hazards that could occur if the food is not processed as planned. Naturally, the HACCP plan looks at supplier certification, which includes film suppliers. In the event hazardous food has left the plant, record keeping is essential for the location and recall of the contaminated food. Accurate record keeping also provides information regarding customer complaints indicating food poisoning or product contamination by showing that adequate controls were in place to avoid or identify a problem.

The importance of record keeping by documenting which roll of film was used and which product lots were packaged with which roll of film cannot be over-emphasized. If a resin supplier found that the resin was tainted, it would be necessary for the resin supplier to track the resin to the film manufacturer. The film manufacturer in turn would track the film made with the tainted resin to the food processor and the food processor would have to track and recall the product packaged in that film. This example demonstrates the necessity of accurate record keeping in order to track film for safety reasons.

A more simplistic example would be a quality assurance (QA) employee noticing a pouch delaminating. The QA person notes the production code on the food and looks up the corresponding film information. The film manufacturer checks his production records. While no one ever knowingly sells a faulty product, perhaps by re-examining the production records, a cause can be assigned. The film manufacturer can subsequently track other questionable rolls of film and initiate a recall. While all involved parties hope to avoid any such incident, the problem can be swiftly handled and corrected by keeping accurate records. Rapid handling will minimize claims against all parties involved and be beneficial toward the re-establishment of good faith.

The process of material identification will be discussed in the next section.

B. TESTING PROCEDURES

The first step in evaluating a finished package is to visually examine the package for attributes and defects such as the cut-length of the package, wrinkles or creases in the film, missing seal impressions, seal width, product fill and product in the seal area. Some of these defects are illustrated in the rejectable package flaw diagrams on pages 74 to 76.

T sting procedures for packaging materials are identified in Table 8-1 on page 77. Additionally, the suggested frequency for performing certain tests in the quality assurance lab and on-line are included in Tabl s 8-2 and 8-3 on pages 78 and 79.

1. Material Identification

a. Method

Each roll of material contains a label which is fixed to the inside of the core. This label should contain a material identification code. It should also have a code that reveals the production date and material lot. Ask your film supplier to identify that code. The material identification code should be checked and recorded before it is placed on the machine. This is particularly important if more than one type of material is being used in the plant.

b. Records

For each production lot, record the type of film used and the film production code. Record the date, time and the corresponding production lot number.

2. Material Gauging

a. Method

Obtain a sample of material from the beginning and end of a roll of film. Make sure that the sample contains the entire width of the roll. Gauge the thickness of the sample at several places across the width of the sample. Check the results with the manufacturer's specifications for that specific material type.

b. Records

Record the thickness across the web at the beginning and end of each roll of material used. Record those numbers with the corresponding roll identification numbers as described in the Material Identification Section.

3. Seal Tensile Strength

a. Method

Procedures for seal strength testing are described under American Society for Testing and Materials (ASTM) F88-68 with references to ASTM "D" 882. Three adjacent samples should be taken from each package end seal being certain not to sample from the center of the pouch where the lap and end seal overlap. The seal strengths should be checked with the manufacturer's specifications and should not fall below minimum recommended seal strengths.

b. Records

Seal strengths should be recorded as pounds per linear inch and reported to the nearest one pound. Seal strengths should be taken at the beginning of each start-up and on a scheduled basis not to exceed four hours apart.

During seal strength examinations, it may be observed that the material will reach its point of elongation before a seal tensile strength is obtained. When this occurs, this observation should be recorded along with the number which is obtained for the seal strength.

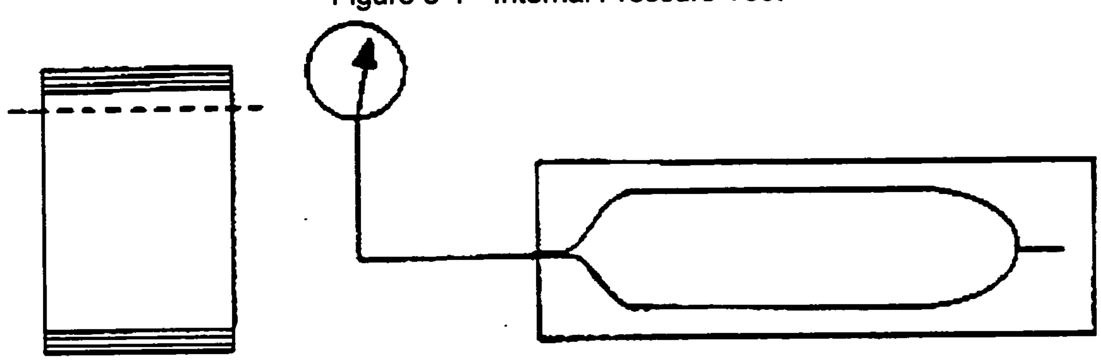
4. Internal Pressure Test

In some literature, recommendations are made for the use of a burst test technique for seal strength evaluation. Often the burst test is recommended to be used along with seal tensile strength examinations. Experience has shown that the traditional burst did not hold all variables constant. People would vary the rate at which the force was applied causing inconsistent results. However, a modified version of the burst test can be used as a quality control test for the pouches. The internal pressure test uses the same apparatus and principles as the burst test. Instead of continuously increasing pressure in an attempt to burst the seal, a specified amount of pressure is applied inside the pouch for a specified amount of time. The seals are then inspected for any signs of failure. In theory, the internal pressure test is a quantitative "Squeeze Test" since both rely on applying pressure to the seal areas.

a. Method

Cut the end from a filled package, empty and clean the pouch thoroughly. Place the pouch in the pressure test unit. The unit must contain parallel plates which restrain the pouch to a 1/2" thickness. Clamp the open end of the pouch shut around the air source. Apply the specified amount of pressure to the pouch and hold that pressure for the specified amount of time (see Figure 8-1). The pressure and time are recommended by the material manufacturer. After the hold time has been completed, release the pressure and remove the pouch from the test unit. Inspect the seal thoroughly for any signs of failure.

Figure 8-1 - Internal Pressure Test



b. Records

Internal pressure testing should occur at the beginning of each start-up and on a scheduled basis not to exceed four hours apart. Records should contain observations of any seal abnormalities which may be visible following the pressure test. Be sure to note the pressure applied, the location of the failure and the type of failure.

5. Seal Junctions

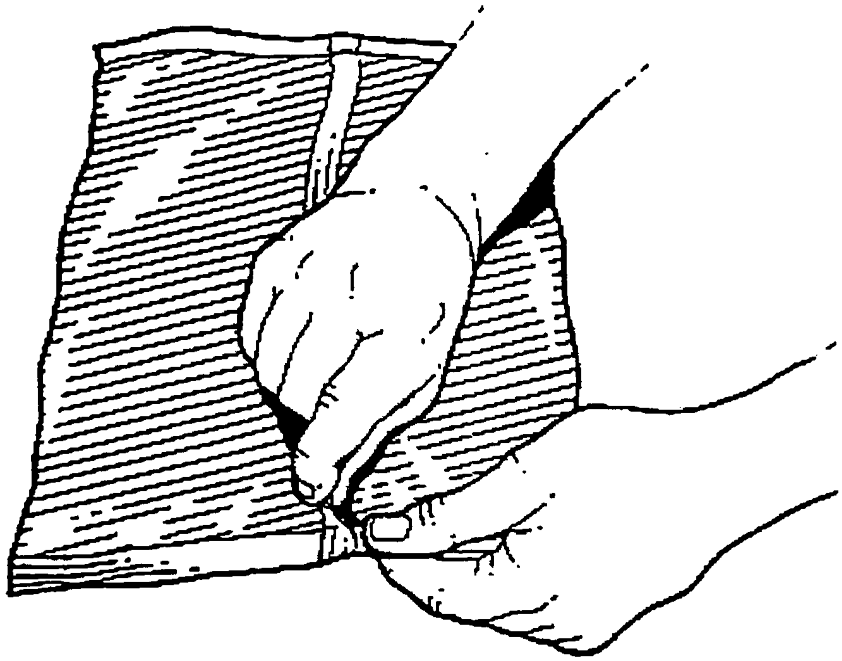
For fin sealed or lap sealed pouches, the thickest area of a pouch is where the lap seal intersects with the end seals. At this area, sufficient heat, sealing time and sealing pressure are required to seal three layers of material. At all other areas of the end seal only two layers of material are sealed. If the outside flap of the lap seal is not properly sealed to the end seal, it would indicate that the inside flap is also improperly sealed. It is the inside flap that will reduce the integrity of the package if it is not properly sealed to the end seal. Therefore, the strength of the seal between the outside flap and the end seal can be used as an indicator of the strength of the seal between the inside flap and the end seal.

a. Method

Place a filled pouch on a flat surface with the lap seal side up. Grasp the lap seal at the intersection of the lap and end seal. Place the other hand on that same end seal, pull the lap seal firmly as if trying to tear or separate it from the end seal. The flap should not be easily separated from the end seal (see Figure 8-2). If the flap is easily separated, improper sealing parameters are in effect.

NOTE: Only pouches which were filled with product at the proper fill temperature are to be used in this examination. Testing of empty packages may create false or misleading results

Figure 8-2 - Seal Junctions



b. Frequency of Examination

The junction seal should be checked closely at each start-up and after each roll change. Routine checks should be made on a scheduled basis not to exceed 30 minutes apart. Results should be recorded.

6. End Seal, Fin Seal, Side Seal Strength Testing

The end seal strength is the most important entity of the Onpack style package. End seal strength can be measured quantitatively in the laboratory. However, the following method provides a quick line check to detect any major faults with the end seal. The same technique can be used to check the fin and the side seal strength.

a. Method

Empty a package and clean thoroughly. Next, cut a 1" wide strip perpendicular to the seal area. Be sure to cut far enough into the package to provide adequate tail strips to grab onto (2" - 3" should be sufficient). Remove the strip from the package. Firmly grasp one tail in each hand and pull in opposite directions (see Figure 8-3, 8-4 and 8-5). The seal should not be easily separated by this method.

b. Frequency of Examination

The end seal str ngth should be checked by this m thod during ach start-up and after each roll change. Routin ch cks should b made on a schedul d basis not to exceed four hours apart. The sid and fin seals should be checked at start-up, role chang , and every 30 minutes. R sults should be recorded.

Figure 8-3 - End Seal Testing

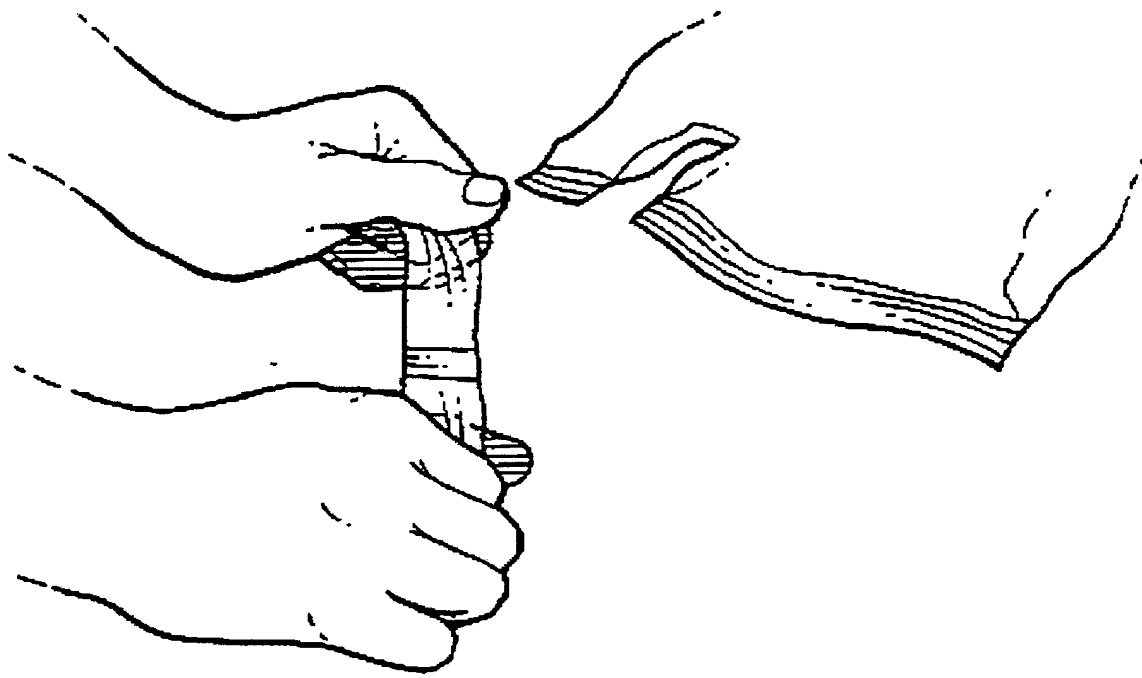


Figure 8-4 - Fin Seal

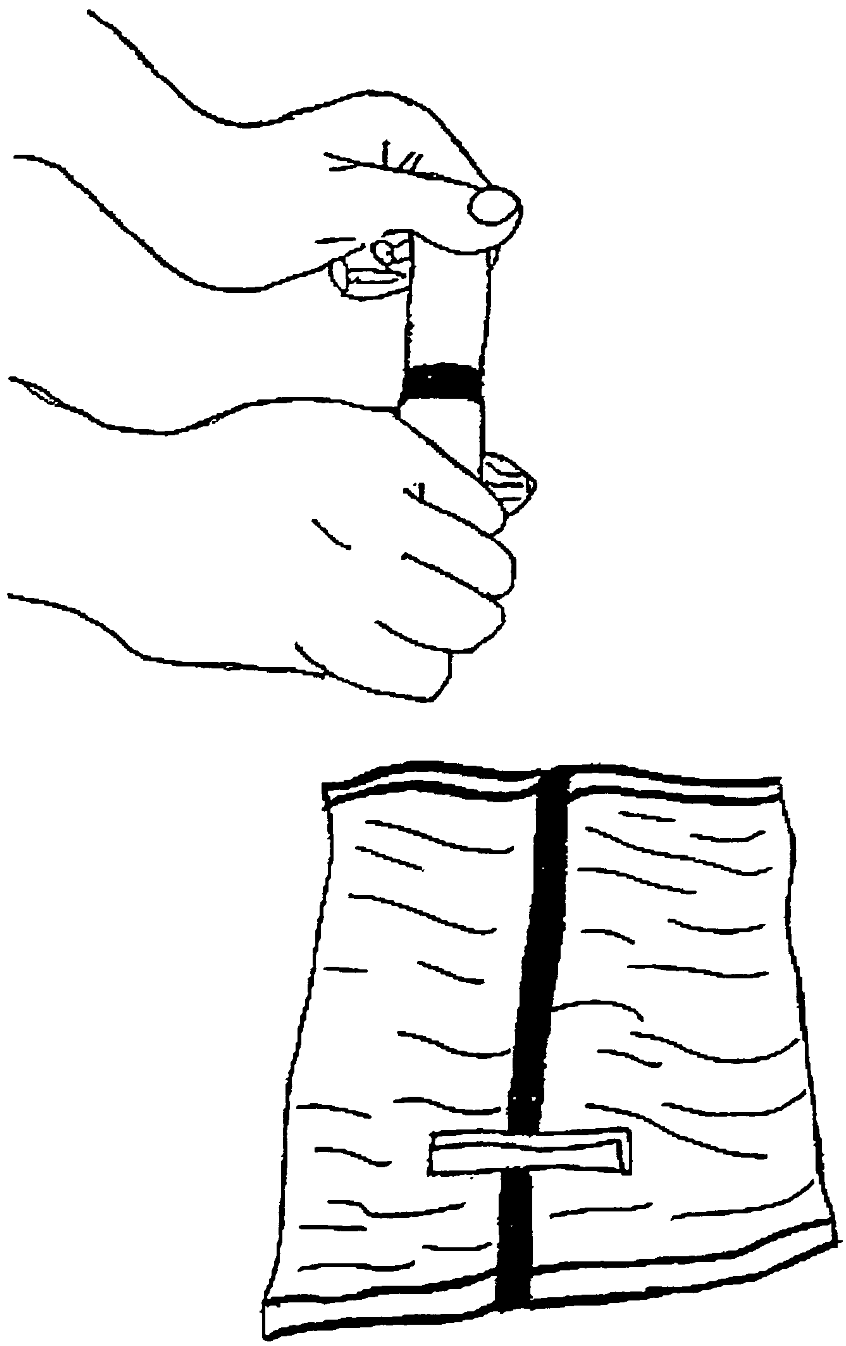
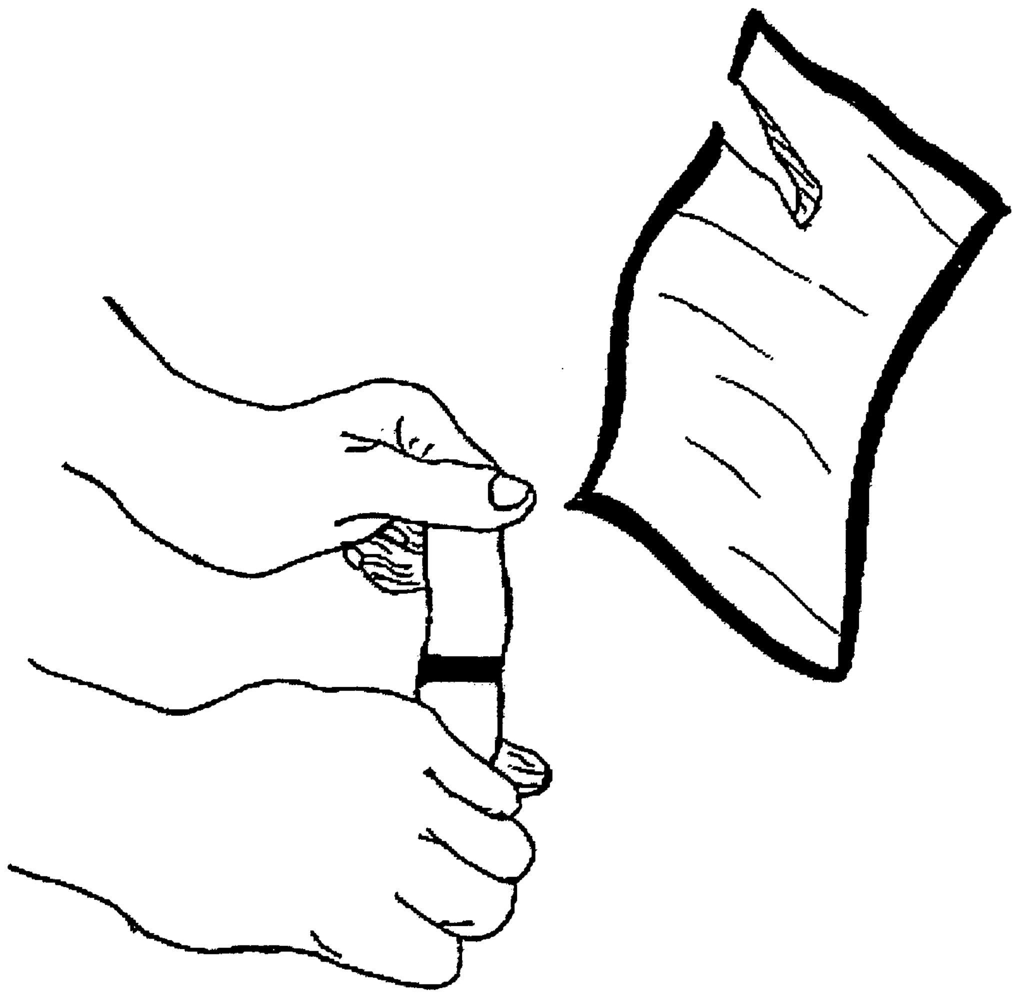


Figure 8-5 - Side Seal



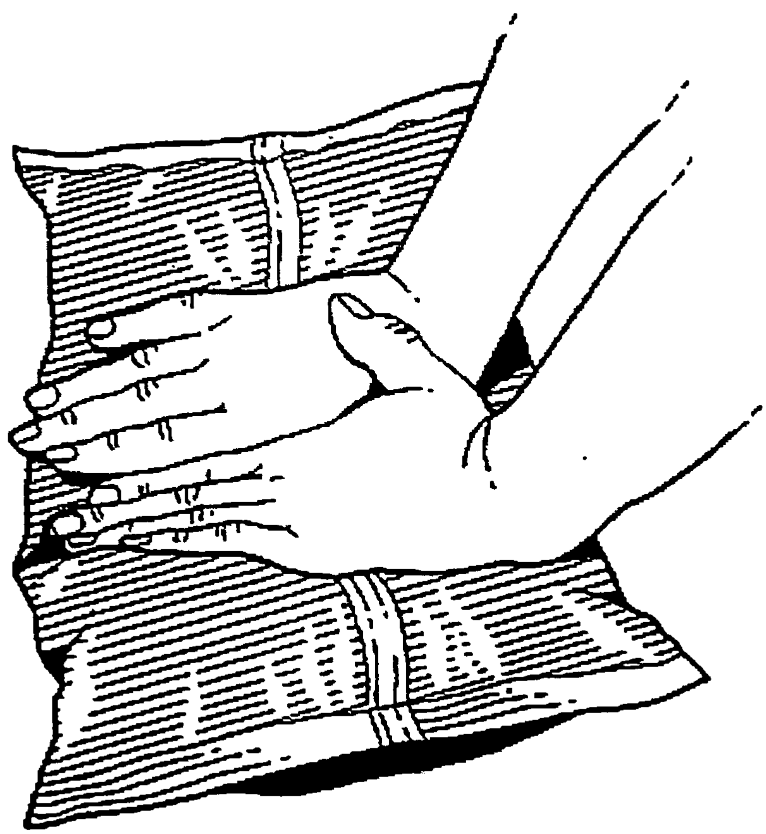
7. Squeeze Test

Another quick on-line check of seal strength is the squeeze test.

a. Method

Place a filled package on a flat surface with the lap seal side up. With both hands apply force downward at approximately the center of the package (see Figure 8-6). Apply this pressure for at least 15 seconds. This action will exert pressure on both end seals. Closely inspect both end seals for evidence of partial or complete seal failure. Special attention should be focused on the area around the junction of the lap and end seals.

Figure 8-6 - Squeeze Test



b. Frequency of Examination

The squeeze test method should be utilized during each start-up and following each roll change. Additionally, the squeeze test should be utilized on a scheduled basis not to exceed 30 minutes apart. R sults should b recorded.

8. Serum Leakers

a. Definition

A serum leaker is a defective pouch package which allows the serum portion of the contents of the package to escape. These leaks are often undetectable on the package surface and the sealant materials appear to be joined together. This definition does not include package defects large enough to allow the fibrous portions or all of the package contents to escape.

There are many variables affecting the stability of a package; including certain ingredients, the percentage of ingredients and equipment. Some ingredients are "aggressive" -- reacting with the package and, at times, resulting in leakers.

A non-comprehensive list of "aggressive" ingredients is noted below:

- ammonia
- butyric acid
- capsicum
- cinnamol (extract of cinnamon)
- cloves
- curry
- ethanol
- high acid products
- horseradish
- jalepeño
- lavender
- loose emulsions (e.g., soy oil)
- malic acid
- mustard
- olive oil
- paprika
- peanut oil emulsions
- phosphoric acid
- pickled herring
- salt (depending on the concentration)
- spice oils
- pepper sauce
- vinegar

NOTE: To ensure a stable product, always consult with your film suppliers prior to coordinating film with product.

b. Serum Leak Detection Method

The serum leak detection test is designed to detect serum leakers that may appear in single service pouches three to seven days after manufacture. It is a simple weight test which accelerates the migration of serum (non-particulate portion) through minute leaks in the package. Most serum leakers can be detected in about four hours from time of manufacture with this test.

c. Procedure

Neatly place one machine's stroke worth of packages, usually eight to 12 packages, side by side on a white flat surface. After they have cooled to 70° to 80°F., cover pouches with a rigid metal plate large enough to cover all pouches. Slowly, place a 50 lb. weight in the cent r of metal plate.

After three hours, carefully examine each package for any evidence of serum migration through the seals. Leaks in any lane are most likely due to inadequate heat and/or pressure during sealing and/or product contamination in a cross (horizontal) seal.

d. Frequency of Examination

It is recommended that this test be performed at the start and once during each shift. Results should be recorded.

Table 8-4, on pages 80 through 82 outlines observed defects and possible causes and solutions for leaker analysis. Additional information on leakers can be found in the Appendix on page 128.

9. Abuse Testing

a. Drop Testing

Drop testing is an effective test for identifying adequate case design, horizontal seal strength and material strength. Numerous drop test procedures exist in ASTM. However, these tests generally destroy the corrugated case. The most effective drop test is the two foot single drop test. Failure rate should be less than five percent, with the failure rates primarily at the bottom of the case. With appropriate case design, most laminated and coextruded films will have a leaker rate of less than one percent. Historical data is invaluable. If a plant has a five percent pouch failure rate and the rate increases to ten percent, the cause needs to be found.

1. Procedure

Along a flat wall, place a mark two feet from the floor. A rinsable concrete floor near a drain works best. Place pouches appropriately in a corrugated container and tape closed. Place the bottom of the case level with the two feet mark. Drop the case squarely such that the bottom of the case solidly impacts the floor. If the case lands on a side or corner of the case, discard that case. Check the case for leakers. Discard this tested product. Repeat the test using a new case and new product. When testing a new case design or a new material, 20 cases should be tested. When testing for appropriate machine setup, testing two to five cases is sufficient.

2. Results

The test must be performed the same way each time to compare tests. After dropping the case, open the case and examine the contents. If no leakers occur, this points out that the horizontal seals are strong, the Vertical Form Fill and Seal (VFFS) machine has the correct sealing and cooling cycle settings, the film type is correct and the case design is appropriate.

If pouches blow out the horizontal seal, this indicates inadequate case design, too much heat on the horizontal seal or insufficient heat on the horizontal seal. Look first at the case. Make sure the package end seals are supported by the case wall and tucked in approximately one inch. If inadequate case support seems evident, cut cardboard inserts and place them inside the case cells to make the inner cells of the case smaller. Then repeat the drop test. If leakers cease, this confirms that a case redesign is necessary.

If leaks continue, examine the horizontal seal. If the pouch is breaking along the seal-pouch interface, the horizontal sealing temperature may be too high. Lower the temperature and re-test. Lower the temperature in 5°F. increments until no leakers occur or the seals appear to be coming apart.

If the seal appears to be coming apart, it is an indication of inadequate heat from the horizontal seal. Increase the horizontal seal bar temperature in small increments and re-test. The temperature may have to be increased only 5°F., consequently small increments are necessary in order to appropriately identify the source of the problem.

If increasing the heat does not help, the film may be delaminating, or the layers of the film may be coming apart. At this point it is best to document the film being tested. Call the film supplier and send several samples of the failed film to the supplier.

If numerous pinholes occur in the corners of the film, it indicates that the film may not have sufficient abuse resistance. The pinholes can generally be eliminated by changing the film structure to one that incorporates nylon.

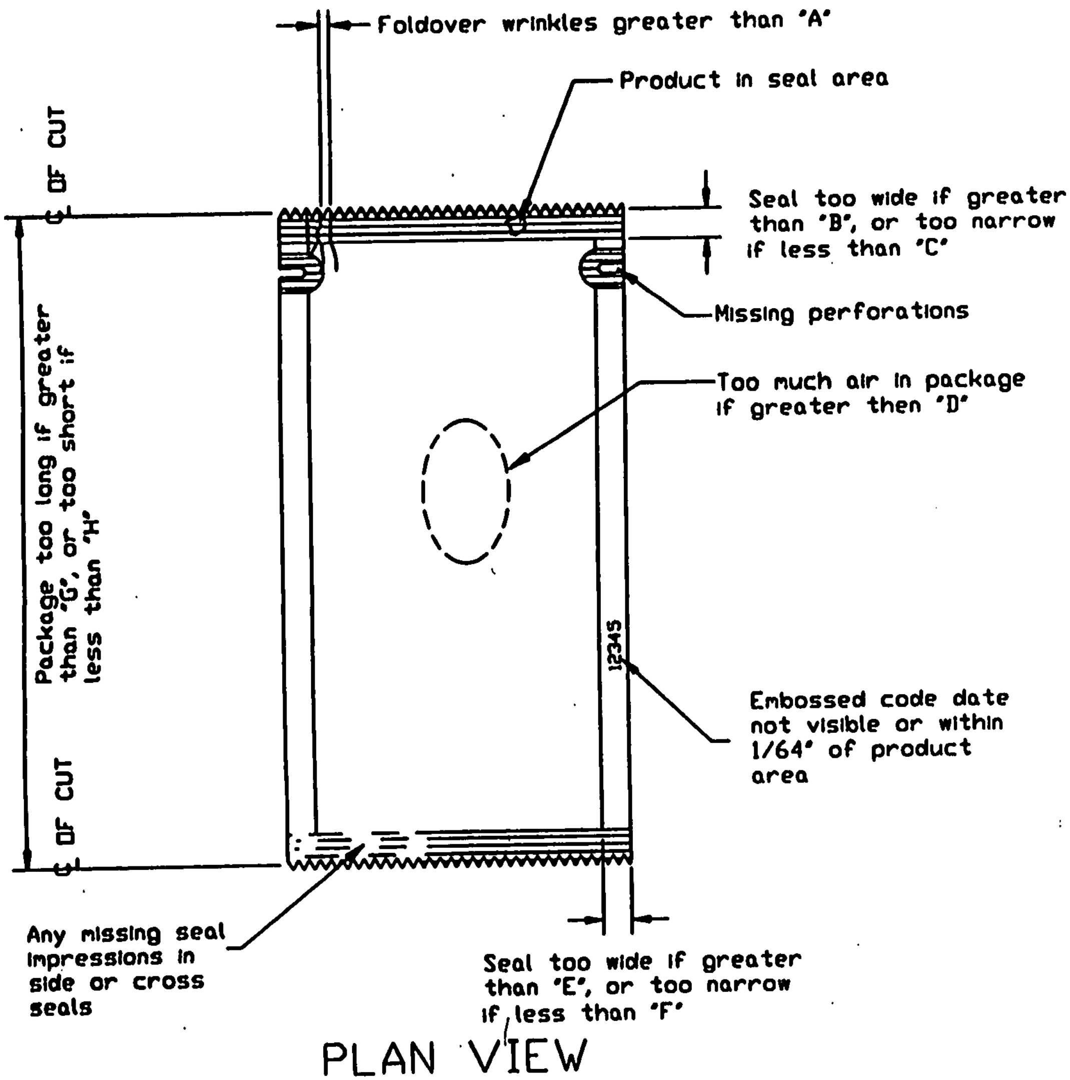
If pinholes occur in the horizontal seal, it generally indicates hot-spots in the horizontal seal sealing wire. Check and make sure the horizontal seal bar cooling water is turned on and is at the proper flow rate. Next, look for build up on the seal bar wire. Take the wire off and check for build-up underneath the seal bar wire. Check and make sure the seal-bar wire is making appropriate contact with the cooling water of heat-exchange surface. For additional information in determining the cause of leakers, see Table 8-4 on pages 80 through 82.

If the side walls of the pouch blow-out, check and make sure the case is appropriately supporting the side walls. If the pouch is not touching the case side walls and is not tucked in one-half inch, then cut corrugation inserts and place them in the case. Repeat the drop test. If the side walls still fail, place a divider between stacks of the packages. If failures continue to occur, it may be an indication that the film does not meet the abuse needs of the customer and a new film type needs to be considered.

When setting the VFFS machine up for a production run, dropping several cases is a quick test to insure the horizontal seal parameters are in order. However, the horizontal seals should still be pulled as added assurance.

Additional information on serum leakers can be found in the Appendix on page 128.

Figure 8-7 - Rejectable Package Flaws



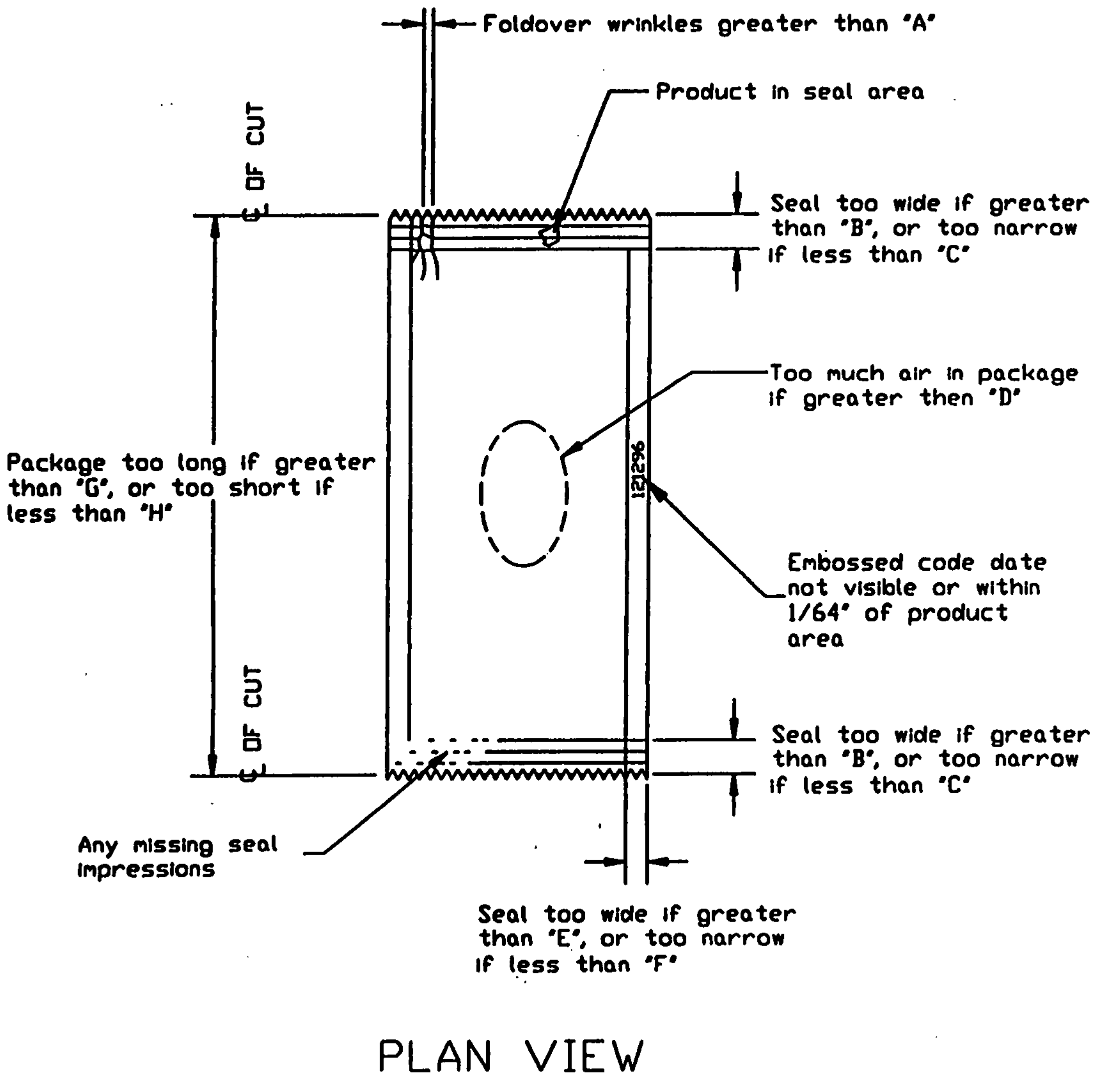
REJECTABLE PACKAGE FLAWS

REF.	FEATURE DESCRIPTION	MEASUREMENT
A	FOLDOVER WRINKLE, MAXIMUM	
B	TOP OR BOTTOM SEAL, MAXIMUM	
C	TOP OR BOTTOM SEAL, MINIMUM	
D	HEADSPACE, MAXIMUM	
E	SIDE SEAL, MAXIMUM	
F	SIDE SEAL, MINIMUM	
G	PACKAGE LENGTH, MAXIMUM	
H	PACKAGE LENGTH, MINIMUM	
I	MAXIMUM PACKAGE WEIGHT	
J	MINIMUM PACKAGE WEIGHT	

NOTE: WHEN CONVERSING ABOUT PACKAGES AND MACHINERY, PLEASE BE SPECIFIC AS TO WHETHER YOU ARE REFERENCING PACKAGE OR MACHINERY SPECIFICATIONS.

REVISION LEVEL 2	REVISION DATE 1/3/97	REVISED BY WAL	APPROVED BY
PROJECT		WINPAK LANE 998 South Sierra Way San Bernardino, Ca 92408	
DRAWN DRT	DATE 07/18/95	PDC- PACKAGE FLAWS, TYPE 10A	
CHECK		Patented	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS .XX ±.010 .XXX ±.005 ANGULAR ±1/2° FRACTIONS ±1/64	SIZE / RELEASE DATE / CAD-SCALE	RAW MATERIAL NUMBER / BEGIN DATE	DRAWING NUMBER TYPE 10A / END DATE

Figure 8-8 - Rejectable Package Flaws



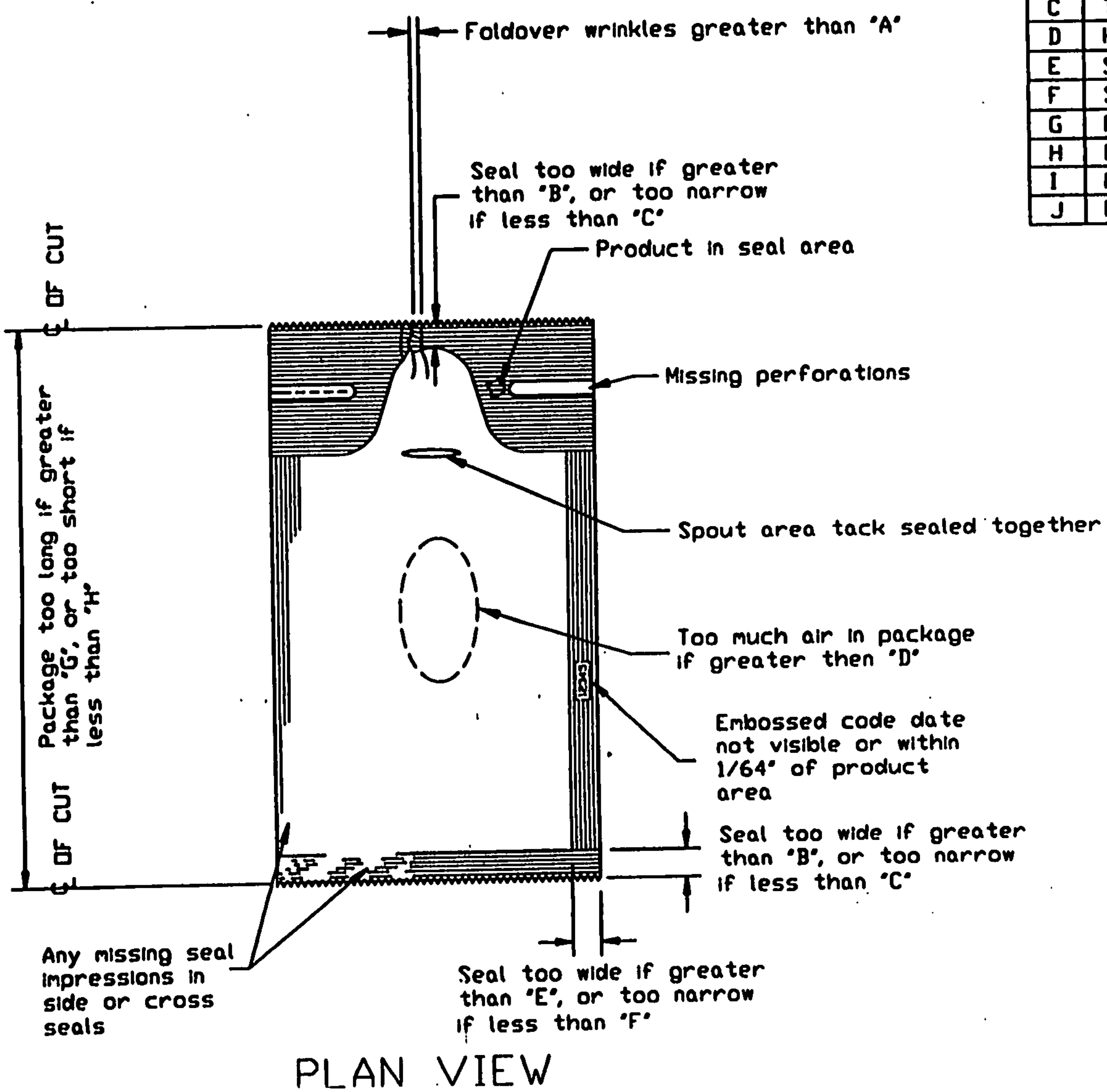
REJECTABLE PACKAGE FLAWS

REF.	FEATURE DESCRIPTION	MEASUREMENT
A	FOLDOVER WRINKLE, MAXIMUM	
B	TOP OR BOTTOM SEAL, MAXIMUM	
C	TOP OR BOTTOM SEAL, MINIMUM	
D	HEADSPACE, MAXIMUM	
E	SIDE SEAL, MAXIMUM	
F	SIDE SEAL, MINIMUM	
G	PACKAGE LENGTH, MAXIMUM	
H	PACKAGE LENGTH, MINIMUM	
I	MAXIMUM PACKAGE WEIGHT	
J	MINIMUM PACKAGE WEIGHT	

NOTE: WHEN CONVERSING ABOUT PACKAGES AND MACHINERY, PLEASE BE SPECIFIC AS TO WHETHER YOU ARE REFERENCING PACKAGE OR MACHINERY SPECIFICATIONS.

REVISION LEVEL 2	REVISION DATE 1/3/97	REVISED BY WAL	APPROVED BY
PROJECT	WINPAK LANE 998 South Sierra Way San Bernardino, Ca 9240E		
DRAWN DRT	DATE 07/18/95	PDC- PACKAGE FLAWS, TYPE 2	
CHECK			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS .XX ±.010 .XXX ±.005 ANGULAR ±1/2° FRACTIONS ±1/64 DO NOT SCALE DRAWING	SIZE / RELEASE DATE / CAD-SCALE	RAW MATERIAL NUMBER / BEGIN DATE	DRAWING NUMBER TYPE 2A / END DATE

Figure 8-9 - Rejectable Package Flaws



REJECTABLE PACKAGE FLAWS

REF.	FEATURE DESCRIPTION	MEASUREMENT
A	FOLDOVER WRINKLE, MAXIMUM	
B	TOP OR BOTTOM SEAL, MAXIMUM	
C	TOP OR BOTTOM SEAL, MINIMUM	
D	HEADSPACE, MAXIMUM	
E	SIDE SEAL, MAXIMUM	
F	SIDE SEAL, MINIMUM	
G	PACKAGE LENGTH, MAXIMUM	
H	PACKAGE LENGTH, MINIMUM	
I	MAXIMUM PACKAGE WEIGHT	
J	MINIMUM PACKAGE WEIGHT	

NOTE: WHEN CONVERSING ABOUT PACKAGES AND MACHINERY, PLEASE BE SPECIFIC AS TO WHETHER YOU ARE REFERENCING PACKAGE OR MACHINERY SPECIFICATIONS.

REVISION LEVEL 2	REVISION DATE 1/3/97	REVISED BY WAL	APPROVED BY
PROJECT	WINPAK LANE 998 South Sierra Way San Bernardino, Ca 92408		
DRAWN DRT	DATE 07/18/95	PDC- PACKAGE FLAWS, TYPE 12A	
CHECK			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES DECIMALS .XX ±.010 .XXX ±.005 ANGULAR ±1/2° FRACTIONS ±1/64 DO NOT SCALE DRAWING	SIZE / RELEASE DATE / CAD-SCALE	RAW MATERIAL NUMBER / BEGIN DATE	DRAWING NUMBER TYPE 12A / END DATE

Table 8-1 - Testing Procedures for Packaging Materials

TEST	TEST METHOD
Tensile Strength	ASTM D638
Elongation	ASTM D3759-83
Modulus Elasticity	ASTM D882
Coefficient of Friction	ASTM D1894-75
Seal Strength	ASTM F88-68
Seal Profile	ASTM D882
Oxygen Permeability	ASTM D3985
WVTR	ASTM D895-79
Bond Strength	ASTM D952
Layer Thickness	Microscopy
Retained Solvent	ASTM F151
Taber Stiffness	Tappi 489
Total Volume	ASTM D2911
Headspace Gas Composition	Mocon/Toray Analyzer
Gloss	ASTM D523, D2457
Haze	ASTM D1044
Melting Point	DSC
Shipper Compression	ASTM D642
Shipper Impact/Shock	ASTM D3332
Abuse Performance	ASTM D4169
Thermal Conductivity	ASTM D3417
Corrugated Mullen Burst	Tappi 810
Short Column Crush	ASTM D2808
Compression (Primary)	FDA C31 177.1390
Residual Monomer Vinyl Chloride	ASTM D3030, D3680, D3749, D4443
Caliper	ASTM D374, D1593, D2103, E252

Table 8-2 - Quality Assurance Laboratory Testing

Test	Frequency	Frequency	Frequency	Frequency	Frequency
	Start-Up	Roll Change	Product Change-over	Every 4 hours	Change in Case Design, Film Type or Product
Roll Identification	X	X			
Material Gauge	X	X			
Seal Tensile Strength	X			X	

Table 8-3 - On-Line Testing

Test	Frequency	Frequency	Frequency	Frequency	Frequency
	Start-Up	Roll Change	Every 30 Minutes	Every 4 Hours	Continuous
Lap Seal	X	X	X		
Lap Seal Alignment	X	X			X
Seal Junction	X	X	X		
End Seal	X	X		X	
Side Seal	X	X	X		
Fin Seal	X	X	X		
Squeeze Test	X	X	X		
Drop Test	X	X			

Table 8-4 - Leaker Analysis for Problem Solving

OBSERVED DEFECT	POSSIBLE CAUSE	PATTERN	ACTION
Short seam cut-off.	1) Machine out of adjustment.	1) Consistent discrepancy between top/bottom seal size on finished packets.	1) Mechanical adjustment of equipment.
	2) Eye spot on film "wanders".	2) Irregular occurrence of unequal seal sizes on finished packets.	2) Set tolerances on eye spot within machining capabilities. Audit packaging materials to determine if eye spot allowances meet specifications.
Fold over in material at seam.	1) Film is loosely wound.	1) Shifting of packaging materials during production. Wrinkles across rollers.	1) Packaging materials rewound if excessive.
	2) Film is "stretched" in some places.	2) Shifting and wrinkling of materials across rollers during production.	2) Stop equipment and realign materials check eye spot variation to determine extent of stretching.
		3) Shifting and wrinkling of materials across rollers.	3) Stop equipment and realign materials.

Table 8-4 - Cont.

OBSERVED DEFECT	POSSIBLE CAUSE	PATTERN	ACTION
Product in seam area.	1) Product delivery is sporadic.	1) Variable packet weights and air in packets. Fill tubes not delivering efficiently.	1) Check O-rings and valves, pressure in pumps. Make adjustments where needed.
	2) Improper fill tubes for target net contents.	2) Difficulty in sealing at top and bottom seam area.	2) Make fill tube replacements where needed.
	3) Inadequate package volume.	3) Product in top and bottom seal areas. Difficulty in sealing.	3) Increase package size; reduce product volume where possible, reduce net contents.
	4) Deformity of sealing jaws.	4) Small channels of product on seal area.	4) May require replacement or re-positioning of jaws.
Pinhole leaks in wall of packet.	1) Defect in packaging material.	1) Serum leaking from small holes in the side of package outside of seam area. Cracks may be visible on layer of packet.	1) Determine if defect is throughout material.
	2) External puncture of packet wall.	2) Product leaking from holes in sides.	2) Identify source of puncture. May be internal to equipment.
	3) Corrosion from package contents.	3) Leaks occurring anywhere on surface. Internal layer of film shows corrosion or weakening of surface.	3) Change film specification to one compatible with product.

Table 8-4 - Cont.

OBSERVED DEFECT	POSSIBLE CAUSE	PATTERN	ACTION
Unsealed seam areas.	1) Inadequate amount of sealant.	1) No bounding in seal area. Gaps or spaces in seam.	1) Confirm thickness of sealant layer against product specifications.
	2) Defective composition of sealant layer.	2) Reduced bond strength in seal area. Seam degenerates over storage.	2) Packaging material defect.
	3) Sealing temperature too low on sealing bars.	3) No bonding in seal area. Leakers occur in same lane of equipment.	3) Test and verify temperatures of heat seal bars. Replace units as needed.
	4) Inadequate pressure on sealing bars, or poor mating of sealing bars.	4) Reduced bond strength in seal area. Leakers will occur in repeat locations.	4) Verify pressure with pressure-sensitive paper. Replace springs as needed.
	5) Inadequate dwell time on sealing bars.	5) Reduced bond strength in seal area. Leakers occur in repeat locations.	5) Reduce operating speeds. Timing adjustment.
Cracks in seal area.	1) Excessive pressure on sealing bars.	1) Small breaks across seal area, or localized.	1) Adjust equipment.
		2) Melted appearance or fracturing at seams.	2) Reduce and verify sealing bar temperatures.
Serum leakers after 30 days.	1) Excessive heat or pressure on package in storage may contribute to serum leaker occurrence from any cause.	1) Serum leaking from package during storage. Very small seam interruption.	1) Reduce storage effect if possible. Increase grade of corrugated material if needed.

CHAPTER 9

SHELF LIFE DETERMINATIONS

This chapter provides general information regarding shelf life determinations.

A. GENERAL INFORMATION

Packaging used for institutional and retail should maintain product quality in a condition near that initially packaged for a desired shelf life. Shelf life testing should be performed on products that have been machine-packaged and not simulated by flat sheet.

The establishment of shelf life is required to determine optimum product performance. Shelf life normally reflects the length of product turnover time beginning with the time product is packaged until it is used by the consumer. See Table 9-1 for the typical shelf life of various products.

B. RECOMMENDED TESTING PROCEDURE FOR SIMULATING SHELF LIFE

1. Both ambient and accelerated testing should be conducted to accurately confirm the ambient/accelerated relationship of a specific product formulation.

   a. Ambient Testing - product is maintained 70°F. + -5° and 50% Relative Humidity (RH).
   One week ambient testing = one week shelf life.

   b. Accelerated Testing - product is maintained at 100°F. and a Relative Humidity (RH) of:

      15% for Liquid Products
      90% for Dry Products

   Depending upon the product formulation, the relationship of test time to shelf life will vary under accelerated testing conditions. This relationship should be established by comparing ambient and accelerated test results. If unknown, use the following rule:

   "One week at accelerated conditions = three to four weeks shelf life."

2. Test Packages: A minimum of 100 machine-filled packages should be used to develop statistically accurate test results.

3. Product-Package Compatibility Checks

   a. Initial check should be performed to document physical conditions at time of manufacture.

   b. Intervals for testing (ambient)
      1) Four intervals (at minimum).
      2) Checks should be made at least monthly.

   c. Intervals for testing (accelerated).
   Checks should be made at least weekly.

   d. Number Test Samples Per Check.

1) Six test samples (at minimum).
2) Six test samples should remain unopened at end of shelf life evaluation for presentation to the customer or for management observation.

e. Test Sample Observation

Both external and internal observation of test packages should be made to confirm no significant change in package integrity or reaction of the product with the package. Package should be observed for the following:

1) A significant deterioration in component bond.
2) Staining of the package interior.
3) Level of foil corrosion.
4) Leaking.
5) Fractures.

Product quality should be monitored by the manufacturer. (Packaging suppliers normally do not have the facilities nor product knowledge to perform this activity for the manufacturer). The product should be observed for:

1) Caking (of dry products).
2) Discoloration.
3) Weight loss or gain.
4) Flavor changes.
5) Moisture and acidity.

Test results per check should be properly recorded. Tests should be structured and executed in accordance with packaging industry standards for testing procedures.

Table 9-1 - Typical Shelf Life of Various Products

PRODUCT	SHELF LIFE (months)
Tomato Sauce	9-18
Pizza Sauce	9-18
Ketchup	9-18
Mayonnaise	6-12
Mustard	6-12
Pie Fillings: Apple, Cherry, Peach, Blueberry	6-12
Ice Cream Toppings: Chocolate, Strawberry, Caramel, Pineapple	6-12
Jams and Jellies	6-12
Salad Dressings	6-12
Cheese Sauces	6-12
Pickles	6-12
Drink Mixes: Margarita Mix, Grape Syrup	6-12
Edible Oils	6-12

CHAPTER 10

SECONDARY PACKAGING

Secondary packaging is an important consideration with respect to product packaging to ensure the maximum protection for packaged products. This chapter provides useful information regarding secondary packaging.

A. GENERAL INFORMATION

To provide the maximum protection for the pouched product, special attention and consideration must go into the design of the secondary package. The most commonly used material for secondary packaging is the fiberboard carton. The carton is the most efficient, economical container which can provide superior support and protection for its contents. Criteria for the secondary package design should be:

1. Establish the appropriate case design(s). Methodology for case designs is included below. Film and corrugation suppliers can also be of assistance in designing cases.
2. Maximize the utilization of the pallet surface.
3. Maximize the pallet cube efficiency.

   Steps two and three will determine which case design is most efficient. Software, such as, Computer Assisted Packaging Evaluation, *CAPE*, is available to quickly ascertain the most efficient pallet space utilization. To obtain more information on *CAPE*, call, write or fax:

   CAPE Systems, Inc.
   2000 N. Central Expressway, Suite 210
   Plano, Texas 75074-5407
   Phone: 800/229-3434
   214/424-3418
   FAX: 214/424-3619

4. In order to determine the paperboard weight and construction that should be used in the case design, the following items need to be considered:
   - Arrangement of cases on pallet
   - Total shipping time—even after pallet is broken down
   - Duration of case palletization
   - Maximize abuse resistance needed to protect contents
   - Allow case, not pouch, to support weight of other cases
   - If the pallets are single, double, or triple stacked

B. CASE DESIGN

When determining the dimensions of a secondary carton, the first step is to establish the number of packages each carton will contain (primarily determined by maximum acceptable case weight for handling ease) and the arrangement of the packages within the carton.

For example, a carton containing six #10 pouches could utilize two practical package stacking arrangements. The first arrangement would be a single stack container in which all six packages are column stacked on top of another (see Figure 10-1). The second option, would be to design a container with two cells. Each cell or compartment contains a stack of three packages each (see Figure 10-2). D signing a six count #10

box to contain three stacks of two packages would not be a practical solution. A carton with three stacks of two #10 packages would be awkward and lack sufficient height to assure a proper glue joint.

Figure 10-1 - Single Stack of Six Packages

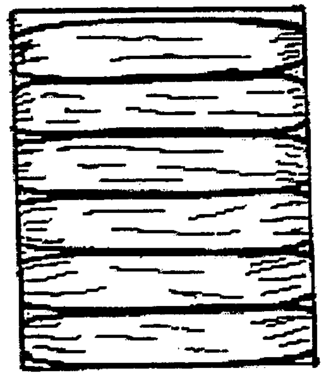
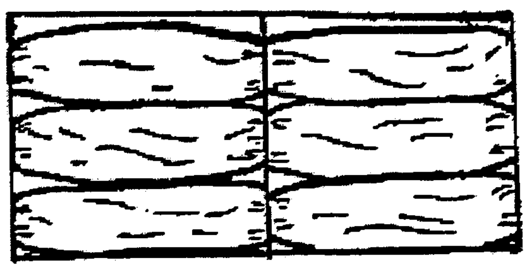


Figure 10-2 - Two Stacks of Three Packages



In some cases, there is only one practical stacking arrangement. For example, a carton containing eight 64 oz. packages would have only one arrangement; two stacks of four packages. One stack of eight packages would result in a tall, narrow alignment, and the carton would easily topple over. A carton containing four stacks of two packages would not have the required height to make the carton joints strong enough to handle the load. Therefore, the only acceptable arrangement would be two stacks of four packages each.

Once the carton contents and package arrangements have been determined, the carton's physical dimensions must be calculated. When working with Vertical Form Fill and Seal (VFFS) packages, always obtain the internal dimensions (ID) first. The determination of ID will be discussed in section C. of this chapter. If the ID of the box container is known, the outer dimensions can be determined by the type of corrugated board used. The corrugated supplier can design the case once supplied with the ID.

C. INTERNAL DIMENSION COMPUTATIONS

The internal dimension (ID) is important in guaranteeing the survivability of packages under abusive conditions. To correctly determine the ID of the case, the cell length, width and height must be calculated. Carefully read the measurement directions. Failure to accurately read these instructions will result in a improperly sized case and an inadequately protected pouch.

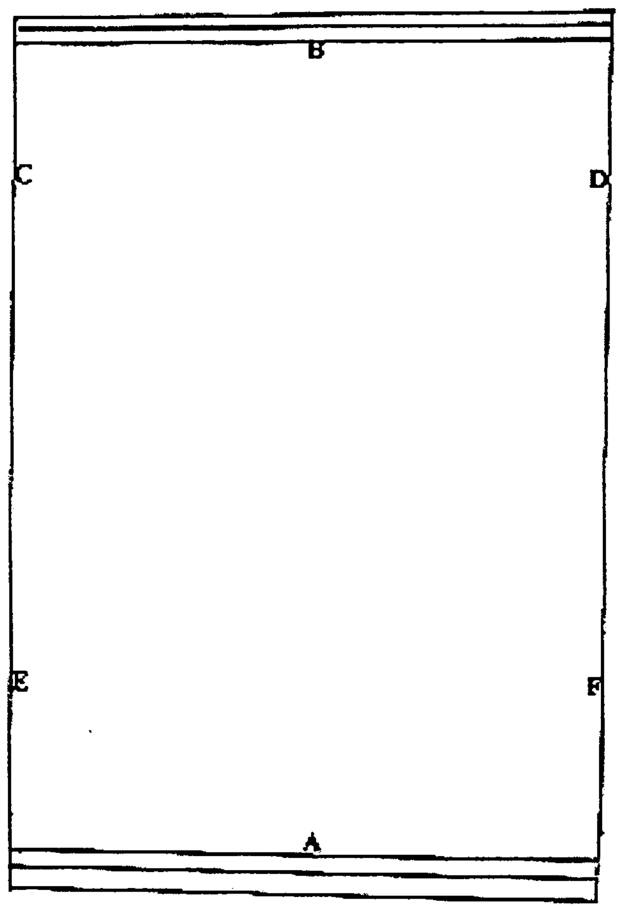
1. Width Calculation – Locate the narrowest width measurement of a full, finished package. Generally, the narrowest section of the package is slightly 1" below the horizontal seal area. For accuracy, the package must be full and have been filled at the same product temperatures as normal. Do not use an empty package, half of the width of the film or half of the width of the film minus the side seal, lap or fin seal. This will result in an inaccurate measurement. Once the narrowest package width is known, subtract 0.5" and the resulting number will be the inner cell width. It may help to refer to Figure 10-3 on page 90. Half of an inch is subtracted from the pouch width in order for the case to support the side wall of the pouch. If the case is dropped, the case side wall receives the shock, not the pouch.

2. Length Calculation – The inner cell length is determined next. Use a full, finished pouch. Take the measurement from the center of the pouch. Do not use the cutoff length or an empty package. Do not include the seals in the measurement. Subtract at least 1" from the filled pouch length measurement and consider it to be the inner cell length for packages up to a #10 can equivalent (100 ounces). Two inches should be subtracted from a filled pouch length when the pouch holds more than the #10 can equivalent or a 100 ounce package.

Similar to the width measurement, 1" or 2" is subtracted from the pouch length to protect the horizontal end seals. Studies prove that on a two foot drop, the shock of the drop goes to the extremities of the pouches, which is the side walls and end-seals. This shock causes the side walls and end seals to tear open or stretch.

By subtracting 0.5" and 1" respectively from the width and length the cell becomes "undersized". This undersizing allows the end seals and side walls to be tucked inwards. Now, when the case is dropped, the shock energy transfers from the pouch side walls and end seals to the sides of the case. The case is stoutly made, so it can withstand these shock waves. The pouches can thus survive a drop and still be intact.

Figure 10-3 - Length and Width Measurements for Case Design

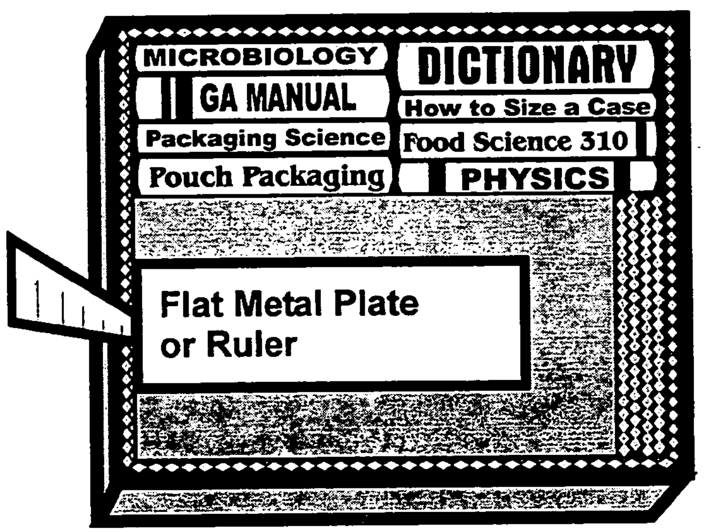


To obtain the inner diameter cell length:
Measure the distance between point A and point B. Subtract 1".

To obtain the inner diameter cell width:
Measure the distance between point C and point D and subtract 0.5". Alternately, measure the distance between point E and point F and subtract 0.5".

3. Height Calculation -- The final inner dimension needed is the height. To obtain the height, stack the correct number of packages in a cell on top of one another. There will be a certain amount of "package-to-package" weight variation in the packaging system. The probability of having a stack of packages in which each package is the exact weight as another will be very small. It is best to measure a stack of packages which are slightly heavier than the target weight, but are still within the normal weight variance for the system. Now, mimic the inner dimensions of the cell that have been calculated. An easy way to perform this is to find a sturdy empty carton. Using scrap corrugation (and books if the box is quite a bit larger than the length and/or width of the pouch) mimic the inner dimensions of the cell. Going back to high school physics, volume = length x width x height. If the length and width are decreased, the height will increase to accommodate the same volume of product. Measure the height at the highest point. An easy way to do this is by placing a ruler down the inner side of the box making sure that it hits bottom. Balance another ruler or flat plate on the top pouch (see Figure 10-4). Read where the ruler intersects for the initial height measurement. Add 0.25 inches to the reading. This is the cell height.

Figure 10-4 - Height Calculation



During transportation the packages in a case, and the cases on a pallet, start moving in harmonic motion (sine wave). The force of the downward motion must go someplace. The bottom pouch within a case receives all the shock energy from pouches in the case. The force from other cases may also be transferred to that case. Luckily, the case(s) have 0.25" of "headspace." This allows the energy to act as a spring. The shock wave acts as a downward force. The energy hits the bottom pouch and deflects causing the pouches to move upward. If the 0.25" headspace was not there, the pouches and the energy would not deflect. The energy would be exerted on the bottom pouches, particularly the end seals, side seals and adjacent corrugation walls of the secondary container. The pouch side walls and end seals, as w ll as th cas side walls, may give way. Thus, for refrigerated and shelf stable product, this 0.25" of headspace in the case is important.

Inner dimension calculations of a cell are the most critical calculation of the case design. With canned and bottled products, the product can support the weight of other cases. However, a pouch cannot depend on the strength of the case itself for protection and stacking strength.

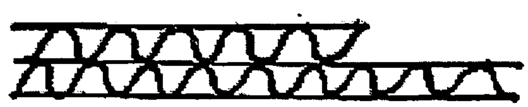
Pouch packaging is in its infancy compared to other food packaging methods. Corrugated suppliers are well versed on can and bottle case design. Few have been involved in the research of pouch case design. To ensure product integrity, it is recommended that either the company or the film supplier provide the corrugated supplier with the ID.

D. CORRUGATED BOXES

Corrugated containers are the most frequently used shipping medium. For shipping purposes, single wall and double wall corrugated boxes are used. A single wall consists of a liner board on either side of a fluted medium (see Figure 10-5). Picture a hamburger. The fluted medium is the hamburger meat with the liner boards being the buns. A double wall corrugate is like a Big Mac®. The two all beef patties are the fluted medium and the liner boards are the buns. One bun (or liner board) separates the patties (or flutes) (see Figure 10-6). Two buns (or liner boards) are on the exposed outside.

Figure 10-5 - Single Wall Corrugate

Figure 10-6 - Double Wall Corrugate



The corrugate is attached to the liner board with an adhesive which is generally starch-based. Technology allows liner board and corrugate to be made to almost any basis weight and thickness. Basis weight is the weight of the material in pounds per 1,000 square feet. The liner board is made of virgin and recycled kraft. The corrugate is made of hardwood and recycled fiber.

When purchasing the corrugate, the terms "Mullen burst test" and the "Edgewise compression test" (ECT) will enter into the conversation. Mullen burst test determines a material's resistance to bursting. ECT measures the stiffness or compression strength of a corrugated material. ECT is an excellent test for determining stacking strength of a material.

Liner boards have historically been selected because of the Mullen burst values. Table 10-1 identifies standard liner boards and corresponding Mullen burst values:

Table 10-1 - Liner Boards/Mullen Burst Values

Grammage (grams)	Basis Weight (pounds)	Mullen Burst Test Score (psi)
127	26	125
161	33	150
186	38	175
205	42	200
337	69	275

Four standard flute sizes exist. From largest to smallest they are: A, B, C, and E. "A" flute is no longer commonly used. "B" flute is generally used for boxes where fair stacking strength is acceptable such as canned goods. "E" flute is not used for shipping containers. "C" is the usual choice.

Table 10-2 identifies standard flutes by basis weight and the corresponding flute flat crush values.

Table 10-2 - Flute Basis Weight/Crush Values

		Flute		
Grammage (grams)	Basis Weight (pounds)	A	B	C
127	26	0.70	1.00	1.15
161	33	0.90	1.25	1.45
195	40	1.10	1.50	N/A

Consequently, a corrugated case can be made to fit the customer's need. The case will be designed based on the weight it must bear and the product it must protect.

If the corrugated containers are going to be in areas of high humidity, inform the corrugated supplier. Fifty percent of the compression strength of a corrugated board diminishes between fifty percent and ninety percent relative humidity (RH). The liner board should be made of virgin kraft in high humidity areas because recycled liner board absorbs water faster. Additionally, additives to the starch adhesive may be necessary to improve its water resistance.

E. DIVIDERS

Dividers serve two functions: (1) they add to case strength; and, (2) they offer protection from puncture and abrasion.

In refrigerated and shelf stable products, the case must protect the product. The case has to bear a great deal of weight, and thus have a good stacking strength.

When considering corrugated box cost, it is cheaper to have a single wall corrugated box than a double wall corrugated box. Unfortunately, the strength of the single wall case may not be sufficient and the double wall strength is needed. Luckily, a less expensive option is available, a single wall case with a divider. Frequently a Z divider in a single wall case is not only cheaper, but is stronger than a double wall corrugated case (see Figures 10-7 and 10-8).

Figure 10-7 - Z Divider

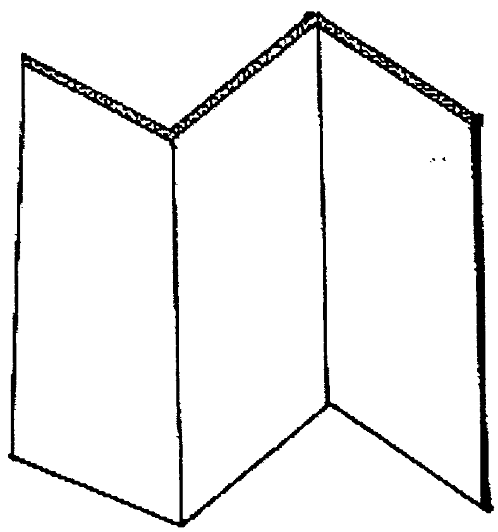
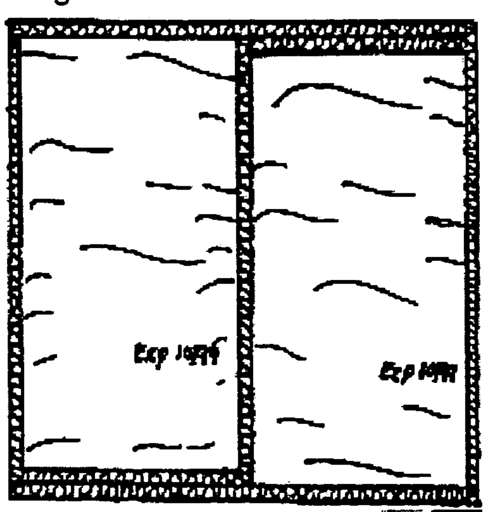


Figure 10-8 - Case with Z Divider



GLOSSARY

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GLOSSARY

Abrasion - Surface damage caused by scuffing or friction.

Acid - A substance characteristically sour in taste; reddens litmus paper. The presence of an acid may weaken or attack a material.

Acid resistant - The ability of a material to withstand attack by an acid.

Activate - To apply a catalyst, heat or solvent which makes an adhesive ready to perform its function.

Additive - A material added to modify. Usually added in small quantities to coating or adhesive to give special properties.

Adhesive (or cohesive), cold seal - An adhesive (or cohesive) from a natural rubber latex system. Surfaces coated with the dried adhesive will stick to themselves with the application of a little pressure and the exposed adhesive coated surfaces shows little tendency to stick to other surfaces.

Adhesive, heat set - An adhesive which requires some heat to develop its maximum properties (cure).

Adhesive, hot-melt - An adhesive applied to a web as a hot liquid; when cool it is a solid.

Adhesive, insoluble - Sometimes called moisture resistant. An adhesive which does not weaken or come apart in water or in a high moisture atmosphere. Can also mean insoluble in other specified organic solvents.

Adhesive, pressure sensitive - A sticky adhesive that bonds with light pressure.

Adhesive, thermoplastic - An adhesive made from a material that becomes liquid with heat and solid when cooled.

Adhesive, thermosetting - An adhesive that cures or hardens and will not soften with heat.

Age resistance - The shelf life of a product. The resistance to deterioration by environmental effects.

Aluminum coating - A coating system in water or solvent in which aluminum powder is dispersed. The coating gives a gray aluminum appearance.

Am rph us phas - Devoid of crystallinity - no definite order. Plastic is normally in the amorphous state at heat of processing.

Anhydrous - Containing no water.

Antioxidant - Substance which prevents or slows down oxidation of material exposed to air.

Anti-skid - A treatment or coating to prevent slip; increase friction.

Apparent density - Weight per unit volume of the sheet.

Autoclave - A pressure vessel normally used to steam sterilize.

Barrier - Quantifiable protection against moisture, grease, aroma, light or gas. Usually reported as Moisture Vapor Transmission Rate (MVTR) and Oxygen Transmission Rate (OTR) over a 24-hour period. Can be improved by coating, laminating or further processing.

Base - The primary web to which coating or lamination is applied.

Base coat - The first applied coat; the base coat will be subsequently over coated.

Basis weight - A method for calculating weight of a paper structure, usually reported as pounds per 500 sheets (one ream) of a structure.

Batch - A quantity of materials prepared at one time or for one purpose.

Benday screen - A mechanical screen having no tonal gradation, used to provide a percentage of solid color.

Beta gauge - A device using radiation to measure the thickness or weight of a web.

Blocking - The undesired adhesion of two or more plies of material, in roll, sheet or package form.

Blown tubing - A method of extruding thermoplastic film through a ring die to make a continuous tube.

Bond strength - A measure of adhesion strength between two laminated plies. Also called "bond."

Bonded - The state of two webs being stuck together.

Breaking strength - The measure of the ability of a material to resist rupture by tension. A measure of the strength of paper, fabrics, film and other materials.

Breathing - The passage of gases into or out of a package.

Brightness - The quality of whiten ss intensity as emitted from the printed or unprinted surfaces.

Calip r - Thickness, generally expressed in thousandths of an inch or mils.

Capacity - The volume available to hold product in a package.

Catalyst - A substance used to speed a chemical reaction.

Cell - A well of small size that takes the ink and transfers the ink in flexographic or roto-gravure printing. Roto rolls are measured by the number of cells per square inch.

Cellophane - Transparent film made from regenerated cellulose. Made in various thicknesses and with various surface coatings to give special properties.

Cement - A common name applied to any adhesive.

Chemical resistance - The ability to withstand damage from a chemical attack.

Chill roll - The roll used to cool or chill the extruded hot plastic. Surface gloss of the plastic is determined by character of the chill roll.

Clarity - Transparency, freedom from haze.

Clay coated paper - A paper stock that has been coated with a binder giving it a clay composition. The coating gives good smoothness and printability.

Cling - A tendency of adjacent surfaces to adhere to each other, as in blocking, except that separation can be effected without damage to either surface.

Coating - A material applied to a web surface.

Coefficient of Friction (COF) - The measure of surface slip. Pull a known weight over the test surface and determine the force necessary to produce the movement.

Coextrusion - (1) A process whereby two or more plastic streams are forced simultaneously through one or more shaping orifices to become one continuously-formed multi-layered structure. (2) Also, the product resulting from such a process.

Cohesion - The internal strength of a substance causing the substance to hold together.

Cold cracking - Cracks which occur under adverse conditions due to embrittlement of a substance at low temperatures.

Cold flow - The slow movement of an adhesive at room temperature.

Cold resistance - Not damaged by exposure to low temperatures.

C llapsing fram - The apparatus on a blown extrusion or coextrusion line which flattens or collaps s the bubbl into a flat tube.

Color art, or Illustration art (instead of a photograph) - The original painting of a pictorial to be used to produce color separations. Often referred to as reflective art.

Color keys - A series of colored film overlays (one color per film) made from film negatives, as an indication of color separation on a design. Colors are not true.

Color overlay - Usually a tissue overlay applied to customer stats and/or production art as an indication of color separation of the elements.

Color separations - Negatives made on camera, or by a scanner, to convert the original color or photograph into the process colors for printing.

Color separated art - All art and copy separated by overlays according to color.

Combining adapter - A piece of equipment used in a cast coextrusion process to bring molten resins together into the desired layer configuration. Often called the "black box," the combining adapter contains channels which direct the resins (melt) until they come together as a sandwich, then exit the combining adapter and enter the die.

Combination plates (or colors) - Plates or colors having both line and screened elements.

Compatible - The capability of a substance being mixed with, or in contact with, another substance and being accepted by the receiving substance with no ill effects.

Compensated art - Production art that has built-in stretch and shrink dimensions, for rubber plates.

Composite art - All art and copy down on base art board.

Composite web - A web of flexible packaging material made up of more than one component -- the total web.

Comprehensive design art ("Comp") - A fairly tight, somewhat detailed version of a design, using whatever material or combinations thereof; most appropriate and economical.

Conformability - The ability of a film or web to be bent or formed.

Contaminants - In packaging, this word usually is used in connection with seals. Contaminants are particles (e.g., product in package, resin, granules) which may be present in the seal area. Contaminants may be designed into the sealant layer to achieve peelable seals.

Conv rter - A company that combines or otherwise processes packaging materials from raw materials not basic to them.

Copolym r - A polymer made from two differ nt monomers.

Core - Generally a spiral wound tube of chip and/or paper on which paper or plastic film is wound. Can also be of wood or plastic.

C r na treating - To treat a surface with a flame or electrical discharge to produce a wetable or printable surface.

Corrosion - Deterioration of a material by chemical action.

Creep - Changes of shape or size with long term exposure to stress.

Critical Defect - A defect which provides evidence that the container has lost its hermetic seal or evidence that there is, or has been, microbial growth in the package contents.

Cromalin - A photo-exposure proofing system which uses film positive instead of engravings. Each separate color is laminated in register to a base stock to produce a full color proof.

Cross direction - The direction perpendicular to the machine direction. The width direction of the web.

Cross-linking - Applied to polymer molecules -- the setting up of chemical links between the molecular chains.

Crystallinity - A state of molecular structure in some resins which denotes uniformity and compactness of the molecular chains forming the polymer. Opposite of amorphous.

Cure - To change the state of an ink, coating or adhesive by application of heat, light, and/or time.

Customer stats - A photoprint copy of the production art, usually having a color overlay, submitted to customer for final approval prior to making engravings. Also can be called Dylus prints or blueline prints.

Dead fold - A fold which will remain in position without sealing or pressure, such as a soft foil.

Delamination - Separation, splitting of layers in a lamination caused by lack of adhesive, inadequate adhesion or by mechanical disruption (as in seal breakage or impact by sharp objects).

Density - Weight per unit volume of a substance, expressed in grams per cubic centimeter, pounds per cubic foot, etc.

Di - A m tal casing, sp cifically shaped, to form plastic melt into films. In extrusions or coextrusions, the die is the last piece through which molten resins pass before they are blown or cast into a film.

Di cut - To cut out a shape using a metal form (die).

Diffusion - Passage of a gas or liquid through a barrier.

Dir ct printing - A printing process in which ink on the image carrier is transferred directly to the web.

Draw-down - (1) Thinning in gauge, or narrowing in width (especially of extruded materials), as a result of windup rate exceeding speed of extrusion. (2) A laboratory test of an ink or coating.

Dry bond - To laminate using heat and pressure. It is normally done by applying an adhesive to the substrate and drying, then heat sealing the film to the substrate all in one operation. This is used to laminate two impervious layers such as film and foil.

Dryer - The device used to apply heat to the web -- an oven.

Dwell - Time of exposure to heat sealing temperatures.

Elasticity - The ability to return to original shape after being deformed (stretched).

Electrostatic - An electric charge. Used as a technique to aid in transfer of ink in rotogravure.

Elmendorf - A test to determine the tear resistance of paper or plastic films, either in machine direction or cross direction.

Elongation - The distance a material has stretched when it reaches its breaking point. Measured in percent.

Embossing - Techniques used to create depressions of a specific pattern in plastic film and packaging webs.

Emulsion - A suspension of fine droplets of one liquid in another.

Engraver's color proof - A white enamel paper proof made from the engravings, using true colors, indicating a close approximation of how the printed job will appear.

Equilibrium - Point at which a substance neither gains nor loses a stated property.

Etching - In printing, an acid pitting process used to develop designs in metal plates. Used in rotogravure rolls.

Extruder - Equipment used in making plastic films. The extruder contains a rotating screw and heating devices which serve to melt, move and mix resin before it enters the die, where it is formed into a film.

Extrusion coating - The resin is coated on a substrate by extruding a thin film of molten resin and pressing it onto or into the substrates, or both, without the use of adhesive.

Finish - The degree of gloss or flatness on a surface or print.

Flam tr ating - A method of making plastic objects more receptive to inks, lacquers, paints, adhesives, etc. The object is passed through an open flame to promote oxidation of the surface.

Flexible - Easily hand folded, flexed, twisted and bent.

Flexibility - The capability of being bent or folded with ease. Sometimes referred to as pliability.

Flexographic printing - Printing from a raised surface, generally rubber plates.

Foil - Any unsupported metal web below .006 thickness; generally means aluminum foil.

Friction - Resistance to slip one surface over another. Measured as coefficient of friction.

Frost line - The point at which molten resin solidifies to form a solid film.

Fusion seals - A bond formed by combining two or more materials through melting or other means so that the joining layers become inseparable at the interface.

Gas packaging (Flushing) - Replacement of oxygen in the free area of a package with an inert gas such as nitrogen.

Gas sterilization - A process for sterilizing a packaged article in an atmosphere of ethylene oxide gas.

Gas transmission - The movement of gas through a packaging material.

Gassing - Development of gas in a package from a reaction of the product with the package material.

Gauge - A standard measure of thickness of film or foil -- measured in thousandths of an inch (mils).

Glassine - A dense paper that resists the passage of grease or oil.

Gloss - A measure of light reflection from a surface.

Grain - The direction of the major orientation of fibers in paper.

Gravure printing - A method of depositing ink from depressions of a specific depth, pattern and spacing which have been ither mechanically or chemically engraved into a printing cylinder.

Gross weight - Total weight of product and package.

Guss t - A fold or tuck in a structure usually applied to a bag having folded sides that will expand on filling.

Halftone - Printing with a plate (or cylinder) composed of dots, or patterns of dots, to provide tonal gradations in a subject.

Halo - An unwanted line surrounding a printed image caused by excessive pressure.

Hardener - A chemical used in a multi-part coating or adhesive system to cause the substance to harden or cure.

Haze - A lack of transparency which causes light to be scattered when it passes through a film. Very clear films have little or no haze.

Heat-sealing - A method of joining heat sealable materials by simultaneous application of heat and pressure to areas in contact. Heat may be supplied conductively or it may be supplied dielectrically.

Heat seal range - The range of temperatures at which an effective heat seal can be achieved.

Heat set - To cause a coating or adhesive to harden with the application of heat. Another word for this is "cure."

Hermetic - Air tight.

Hiding power - A property of an opaque coating or ink to prevent show through of substrate.

High density paper - A general term used for paper that is processed to give solvent hold out; these sheets are thin for their basis weight.

Hold down roll - A roll designed to keep a web in contact with another surface.

Hold out - Describes the ability of a sheet of paper to resist the penetration of an ink or coating. Sometimes called surfacing.

Hoppers - Funnel shaped containers which hold resins before they enter an extruder.

Hot melt - Any material capable of being made fluid with heat.

Hot tack - The capability of a heat seal joint to hold together while still hot from the heat sealing operation.

Hydrom t r - A device to measure humidity.

Hygroscopic - Capable of taking up moisture from the atmosph re.

Impact strength - The resistance of a package to a sudden blow or dropping; the amount of force, or moving weight necessary to break or penetrate a material.

Impr ssion - To make a mark on a web. Usually for decoration. One complete print copy is called one impression, and print quantity is often ordered by the number of impressions.

Impulse sealing - A heat sealing technique in which a pulse of intense thermal energy is applied to the sealing area for a very short time, followed immediately by cooling.

Inhibitor - A chemical used to slow down or stop a chemical reaction. Normally to stop oxidation degradation.

Insider or outside flap - Material which is extended beyond opposite sides of a lap seal. The pouch package contains a portion of a flap on the inside and outside of the package on the lap seal side.

Intaglio - Rotogravure printing.

Internal bubble cooling - In blown film manufacturing processes, a system for cooling the inside of the bubble simultaneously with the outside. "IBC" maximizes machine efficiencies and film properties.

Ionization - In corona treating, a high electrical voltage which causes atoms in the air to be converted into ions.

Joint - The point of joining two surfaces by an adhesive.

Keyline art - Composite art with common keylines to be used by engraver as trap lines.

Kraft paper - A high strength paper made of sulphate fiber pulp. Kraft pulp can be unbleached, called natural (light brown) or bleached (white).

Laminant - A product made by bonding a combination of films, foils, plastics, papers or other material in sheet or web form.

Laminate - To unite layers of materials with adhesives.

Lamination - The process of preparing a laminate which consists of two or more flexible barriers bonded together.

Land - The flat lips of an extruder die.

Leakers - Defective packages which permit the undesirable escape of any portion of the cont nts by sifting, exudation, permeation, etc. or a loss of vacuum by an evacuated packag .

L tterpress - Syst m of oil ink printing using a raised surface transferring the design directly from the plat to the substrate. Available sheet fed and rotary.

Lightfast - Color retention when exposed to light.

Line printing - Printing with a plate composed of solid areas only (no screened elements).

Low finish - A defective surface with a dull or poor appearance.

Luster - A semi-gloss surface appearance.

Machine direction - The dimension that corresponds to direction run on the machine. The direction of alignment or orientation is also referred to as "longitudinal", "with the grain", and "MD" (Machine Direction).

Machine finish - The flat, dull surface of paper on both sides. Referred to as "MF."

Machine glaze - A sheet of paper having a smooth, semi-glossy surface on one side caused by the intimate contact of this side to a highly polished, large diameter dryer during manufacture. Referred to as "MG."

Major package defect - A defect that is likely to result in failure or reduce significantly the usability of the package for its intended use.

Make ready - Preparing a machine to perform its operation -- often used in printing. Sometimes called set up time.

Mandrel - A forming device upon which paper is wound to form a tube.

Mask - To cover up a defect by applying a covering substance that gives a desirable effect.

Melt - A polymer resin or resins in the molten state.

Melt index - Measure of flow of a plastic resin. The amount in grams, of a thermoplastic resin which can be forced through a 0.0825 inch orifice when subjected to 2160 gms force for 10 min.

Metallizing - A vacuum process of electrically applying a very thin layer of tin or aluminum into the very smooth surface of a substrate.

Mica coating - A coating mix incorporating finely ground mica flakes which orient themselves on the substrate surface to act like tiny mirrors reflecting light.

Micrometer - A device used to measure thickness.

Mil - A unit of measur ment equal to 0.001 inch.

Mileag - The amount of area covered by a giv n amount of liquid coating.

Min r package defect - A defect that does not significantly reduce the usability of the package for its intended purpose, or that is a departure from established standards having little or no bearing on the effective use of the package.

Moisture vapor transmission (MVT) - A rate at which vapor will pass through a material. The conditions of tests must be specified for temperature and moisture difference.

Multi-layered structure - A structure that consists of two or more continuous layers or plies of material. Note: Processes such as coextrusion, lamination, extrusion coating and solution of dispersion coating can be used to make multi-layered structures.

Multirib end seal - Package seals found on the two ends of the pouch with each end seal consisting of several (usually 4-5) fusion seals in parallel. The fusion seals are separated by areas of non-fusion creating a ripple.

Nip rollers - Used on film handling equipment (e.g., presses, laminators, extruders) as pulling devices to control film speed and tension. To avoid slippage and maintain control, this apparatus consists of two rollers, one moving clockwise and one moving counterclockwise.

Offset printing (Lithography) - A process of fine printing using the principle of water and oil not mixing. Process uses an etched plate which transfers design to a rubber blanket, then to substrate. Printing done either sheet fed or rotary.

Opacimeter - An instrument to measure the opacity of a web.

Orientation - Stretching a plastic film either by cold drawing or under carefully controlled conditions so that the molecules are mechanically rearranged from a random to an orderly structure, greatly increasing the strength in the direction of stretch.

Oxygen transmission - Measures the amount of oxygen which will pass through a material under certain standard conditions.

Package cut off length - Measurement of the length of the finished package including the seal areas.

Paper - A mat of fiber formed into a sheet or web that has properties of strength, stiffness and opacity.

Peaking - The condition which occurs when a non-distensible flat web material is forced to conform to a three-dimensional product with the result that the excess material gathers and folds into sharp points or "peaks."

Pe lable seals - Seals that break at the interface of the two sealant surfaces.

P rmeability - Ability of gas, vapor, or liquids to pass through structure.

Pinholing - Small holes in webs not normally visible to the eye.

Plasticizer - A chemical added to plastic materials, lacquers, paper stock, etc. to impart either softness or flexibility.

Polar - A concentration of plus or minus electric charges on a molecular scale. Polar materials are easy to adhere.

Porosity - A measure of air passage through a given area of paper or board in a measured length of time. Test is made on a "Densometer."

Pot life - The period of time during which a liquid resin or packaged adhesive can be stored under specified temperature conditions and remain suitable for use.

Pouch - A flexible container usually heat sealed. Normally designed to contain small quantities of product such as coffee or sugar.

Process colors - The colors used in halftone printing to produce pictorials. True process colors are yellow, magenta, cyan, and sometimes black. Occasionally, a color such as brown may be substituted for one of the process colors.

Product length - Measurement of length from the beginning of the product to the end of the product. This measurement excludes the seal areas.

Production art - The final, finished art from which film negatives will be made for engravings. Also called mechanical art, black and white art.

Ream - Consists of a specified number of sheets of a specified size. The ream most widely used for packaging materials consists of 500 sheets.

Relative humidity - Ratio of the quantity of water vapor present in the air to the quantity which would saturate it at any given temperature.

Relief - A raised pattern of image.

Resin - A complex organic material of high molecular weight that is solid or semi-solid at room temperature. It is a base material used in coatings and adhesives, and in plastic films -- usually in the form of small pellets.

Reverse print - Show through printing, printed on the inside of a film and seen through the film.

Rotogravure printing (Roto) - An intaglio process of rotary printing from tiny etched cells in a copper covered roller surface. Often overchromed for longer wear. Does fine printing along with half-tones and gradation of tone.

Rough d sign art (Rough) - Basic, conceptual ideas, usually done freehand, using markers or colored pencils, not necessarily to size.

Scr w - A cylindrical object with heavy threads positioned inside a barrel or extruder. The function of the screw in the extrusion process is to move resins through the barrel and provide frictional heat to assist in melting the resins.

Seal - A continuous joint of two or more surfaces of sheet material such as made by fusion or adhesion.

Seal contamination - Foreign matter in the seal area such as, but not limited to, water, grease or food.

Seal strength - The measured force required to separate a seal.

Seam - A noncontinuous joint of two or more surfaces of sheet material such as made by stitching, spot adhesions or intermittent fusion.

Shelf life - The time a packaged product will remain in a usable state.

Shrink wrap - A film wrapped around a product and sealed. It is then exposed to heat and the film shrinks to the contours of the product.

Slip - The degree of "slipperiness" of a material or its comparative lack of "drag" which is essential for ease of handling and good machinability.

Slit - To cut a web to width.

Smash - Halo effect or double outline in flexo printing.

Softening point - Temperature at which a thermoplastic material can easily be deformed.

Solvent retention - The undesirable condition which occurs when the solvent in inks, coatings, and/or adhesives are not completely dissipated.

Specific gravity - The density (mass per unit volume) of any material divided by that of water at a standard temperature.

Spew - The presence on a plastic surface or a coated web surface of a material from the film or coating, such as plasticizer from a vinyl film.

Splice - To join the ends of a web to make a continuous web.

Stamping - Using a hot press to apply a metallic design to a web.

Stretch wrap - To package a product in a wrap that is stretched over the product.

Striation - A streaky pattern usually s en running in the machine direction, due to web distortions.

Strik -through - Discoloration or defects of appearance occurring where an adhesive, coating, or ink, applied to one side of a web (usually paper), has migrated or wet through to the other side before setting.

Strip coating - A coating, usually heat seal, applied in a restricted area (strip) on the web.

Substrate - Any material to which adhesives, inks, or coatings are applied, printed or extruded. Substrates can include film, foil, paper, board, etc.

Supercalender - A series of rolls operating under high pressure to develop compactness, smoothness and gloss on paper.

Tack - The stickiness of an adhesive; how it holds a surface in light contact.

Tear strength - The amount of force necessary to tear a material once the tear has been initiated.

Tensile strength - The amount of force necessary to break a material by pulling it.

Thermoformability - A film property which is related to the ease of molding or forming the film under increased temperatures so it takes and maintains a specific shape.

Thermoforming - A forming method in which heat-softened film or sheet is forced against a cold mold and permanently takes on the contours of the mold.

Thermoplastic - A plastic that will soften when heat is applied and harden upon cooling.

Thermoset - Used to describe a plastic which sets or hardens (cure) under heat. Subsequent heating, though it may soften the structure somewhat, cannot restore the flowability that typified the uncured resin.

Tie layer - In coextrusions and laminates, the layer of material used to adhere two other layers which do not naturally "stick" together.

Transparency - Usually refers to the photograph to be used to produce color separations for a pictorial on a package.

Treating - Introduction of electrostatic charges to the surface of the film to slightly change the molecular structure of the surface for better acceptance of inks, adhesives and other applicants.

Unsupported - A material used by itself and not as part of a structure of a lamination.

UV stabilizer (Ultra-Violet) - A chemical compound which protects the resin from damage by UV rays.

Vacuum m tallizing - Process in which surfac s are thinly coated with metal by xposing them to the vapor of metal that has been vaporated under vacuum.

Vacuum packaging - To remove the air in a package.

Vacuum s al - A seal that will hold the vacuum in a package.

Varnish - A liquid resin coating applied to a surface that cures to a hard, glossy, protective film.

Viscosity - The measure of the flow of a liquid. A high viscosity liquid will flow slowly.

Water finish - A high finish produced on paper or paperboard passing through the calendar stack by spraying water on one or both sides.

Water vapor transmission rate (WVTR) - A measure of moisture pickup through a barrier web in a given time.

Wet strength - The property of paper or board treated to retain its strength after becoming wet or saturated with water. Expressed as percent wet of dry strength; usually tensile strength.

Winder - The end station of a manufacturing process where the material is wound onto cores.

Yield - The area per unit weight of a material, usually expressed in square inches per pound.

Yield point - The amount of time or heat which causes the permanent deformation of the packaging material under a given load.

APPENDIX

PURCHASING CHECKLIST FOR PACKAGING MATERIALS

The following guidelines are intended to provide a checklist for critical information to be determined between packaging suppliers and single serving packagers in the sale or purchase of packaging materials. Specific product requirements have not been designated, but should be determined individually by each company as appropriate.

FILMS AND LIDDING MATERIALS

Packaging Specifications

- ❑ Material laminations
- ❑ Web and wind specifications
- ❑ Cut off repeats
- ❑ Splice specifications
- ❑ Shipping, handling and pallet specifications
- ❑ Minimum runs
- ❑ Critical Defect Analytical Tolerance (acceptable quality levels - AQLs)

Artwork Development

- ❑ Art statistics from customer
- ❑ Finished art requirements
- ❑ Color tolerances and target standard
- ❑ Specifications for placement of artwork on web

Product Compatibility

- ❑ Product shelf life requirements
- ❑ Analytical tolerances for packaging material

Material Leadtimes and Inventory

- ❑ Schedule of production based on delivery
- ❑ Age consideration for laminated material

Regulatory Compliance

- ❑ Department of Transportation, Food and Drug Administration, United States Department of Agriculture, etc.

CORRUGATED PACKAGING MATERIALS AND TRAYS

Packaging Specifications

- ❒ Liner and medium basis weights
- ❒ Panel dimensions
- ❒ Correct corrugated Mullen Test for given product weights
- ❒ Printed box maker certificate
- ❒ Correct printing color
- ❒ AQLs (acceptable quality levels - defects)

Case Design

- ❒ RSC
- ❒ Partitions for increased stacking strength
- ❒ Die cut machine set up boxes
- ❒ Case should be designed to eliminate overhand and underhand on pallets
- ❒ Shipping and handling tests

CUPS AND CUP TRAYS (WEB STOCK AND PRE-FORMED)

Packaging Specifications

- ❒ Material laminations, coextrusions, coating
- ❒ Web and wind specifications
- ❒ Splice specifications
- ❒ Condition of web
- ❒ Shipping, handling and pallet specifications
- ❒ Critical Defect Analytical Tolerances
- ❒ Meets dimensional tolerances (preformed)
- ❒ Yield

Product Compatibility

- ❒ Product shelf life requirements
- ❒ Analytical tolerances for cup material

Material Leadtimes and Inventory

- ❒ Schedule of production based on delivery for both sheet stock and preformed
- ❒ Age consideration for laminated and/or coated material

CHECKLIST FOR FINISHED PRODUCT REQUIREMENTS

The following guideline provides a checklist of critical information to be discussed between purchasers of single serving condiment items for foodservice and the manufacturer (or vendor).

Packaging Requirements

- ❑ Type of machine, make and model
- ❑ Type of package, size and style
- ❑ Type of packaging material
- ❑ General roll dimensions (width tolerances, core diameter, roll max. O.D., rewind figure)
- ❑ Splicing and tape
- ❑ Expected output per minute

Product Requirements

- ❑ Fill temperature
- ❑ Qualitative formula of ingredients
- ❑ Shelf life required/general package performance

Physical Requirements

- ❑ Tensile strength
- ❑ Mullen burst
- ❑ Tear seal strength
- ❑ Bond strength
- ❑ Coefficient of friction
- ❑ Basis weight
- ❑ Caliper
- ❑ Others

Printing Required and Method

- ❑ Flexo or roto
- ❑ Number of colors - line and process
- ❑ Over lacquer
- ❑ Eye spot position/color
- ❑ R peat tolerance
- ❑ Substrate printed

Finish d Product Consid rati ns

- ❐ Cost
- ❐ Order quantity
- ❐ Packing and shipping
- ❐ Regulatory compliance (e.g., DOT, FDA, USDA)
- ❐ Expected AQLs (acceptable quality levels)

SPECIFIC PROCEDURES THAT WILL IMPROVE THE DAY TO DAY PERFORMANCE OF PORTION CONTROL LIQUID MACHINES

Machine startup checklist - Develop specific task lists for portion control (pc) equipment that itemize all of the steps required for a machine startup or changeover. The lists are used to verify that all tasks are completed. They can also be used to sequence events that will result in the most efficient startups and changeovers.

Standard operation conditions - Develop specific standard operating conditions at which the different specifications run most efficiently on the pc equipment. These conditions should be documented and verified on each shift by each operator for every machine. The following steps can be used to generate these conditions:

1. Identify specific machine parameters that can or should be measured or controlled. The parameters would include cycle time, seal temperature, air pressure, etc. The Curwood service group and the machine manufacturer would be good resources for identifying these parameters. A rule of thumb might be that anything that can be adjusted should be controlled.

2. Record these parameters for a specific time period (one to four weeks) to establish current conditions.

3. Evaluate the values obtained to establish set points and the corresponding allowed variance (i.e., 295°F. +/- 15°F.).

4. Any change to a standard condition would require approval by the appropriate or designated person in authority.

5. Any new film would have standard conditions developed during the trial and scaleup time period.

If resources are available, a process capability study can be completed before the standard operating conditions are completed.

DAILY MACHINE CHECKLIST FOR BEST OPERATION OF PORTION CONTROL VERTICAL FORM/FILL/SEAL MACHINE TO PACKAGE LIQUID PRODUCTS

1. Use a pyrometer to check the temperature on all side and cross seal heaters. The temperature should be within +/- 15° F. of the "set" position. If this is not the case, maintenance should be called to calibrate the controller. The pyrometer should also be checked periodically to insure that it is reading properly.

2. Check all infeed idlers (both front and back) to insure that they are concentric and are square to the machine frame.

3. Check fill tube alignment. Proper alignment will cause equal "pillowing" of the front and the back side of the package.

4. Check pull wheels to make sure that the coefficient of friction and the pressure is equal all the way across.

5. Check to make sure that the slitter blades are slitting down the center of the side seals.

6. Check the cross seal impression using TIPI paper or carbon paper to insure that all springs are good and that the head/jaw is not warped.

7. Check the sensitivity of the photo eye to make sure that the green light blinks on the eyespot. It should blink only once.

8. Check bag length and head space.

9. Check that the main air pressure to the machine is at the recommended level.

10. Check to make sure that the tension on the leather brakes is even both front and back. Replace the leather strap if it has been stretched out.

THE USE OF TIPI PAPER ON VERTICAL FORM/FILL/SEAL LIQUID PACKAGING EQUIPMENT FOR STARTUP AND PREVENTIVE MAINTENANCE CHECKS

TIPI paper is an excellent tool for diagnosing seal bar problems on VFFS packaging equipment. It is a coated paper that turns different shades of blue depending on variations of seal bar temperature and pressure. Additional information on TIPI paper begins on page 122.

TIPI paper is best used in conjunction with clear setup film during packaging machine startups and/or troubleshooting. The TIPI paper is simply spliced onto the sealant side of the web and cycled through the machine with the filling cycle off. The clear film will act as a window so the operator can see the paper in the seal area. The clear film also provides a way for the operator to inspect filling cycles as the machine is running at normal conditions. Startup procedure is as follows:

1. Place the clear roll of setup film on one unwind.

2. Tape the entire leading edge of the TIPI paper onto the sealant side of the setup film so the writing is visible and leave the tail loose.

3. Turn off the product pumps and the cutoff knife and cycle the machine until the paper has passed through the seal bar area.

4. Inspect the TIPI paper for temperature and pressure variations, make necessary adjustments and repeat the test until results are acceptable.

5. When acceptable seal bar conditions are reached, check the product filling cycle as follows:

    a. Watch the fill cycle through the clear film to confirm that it is not overfilling and touching the fill tubes.
    b. Confirm that no drips or splashes are occurring and that proper suck back is taking place.
    c. Check the seal areas of the filled pouch for product contamination.

6. When the fill cycle adjustments are complete, the setup film can be removed and the machine returned to normal production.

TIPI PAPER

This will introduce you to TIPI paper, a temperature-pressure sensitive paper which can be of great help to you in the operation of your heat sealing and processing equipment. It is economical, so that it can be used on a routine basis to reduce your packaging waste and improve your package quality. The paper is used to check the sealing heads of your packaging equipment so that you may determine if there is even die pressure and sufficient heat for consistent seals. This can be accomplished without breaking the web and interrupting production, and with a minimum loss of time and material. The paper produces a sharp, permanent picture of the seal being produced, under production conditions.

The paper is quite sensitive. It will not respond unless there is sufficient heat, but then the response is very fast (less than 0.1 second) and the picture of the seal is very crisp and sharp. The impression on the top sample sheet shows how the paper responds to the perforated sole plate of a steam iron. The white spots are the steam holes where there was no pressure applied to the paper. Note the sharp edges of the holes. A cut or nick in a sealing die will show up in the same manner, and if a sealing die is misaligned, the area of lesser pressure will not be as dark as the rest of the impression. You know where, and how well the die is sealing by the picture on the paper.

The paper is provided in two temperature ranges, 140° to 180°F. (60° to 82°C.) and 200 to 300°F. (93° to 149°C.). At the lower temperatures of the ranges the paper turns light blue; the color then increases, up to the maximum of the range. The paper is clean, easy to use and is provided in packs of convenient sizes so it can be kept on hand at the machines where it is needed. The 200° - 300° paper is designed for normal heat sealing operations and the sheet attached to the samples suggest methods of using the paper to obtain the best results. The 140° - 180° paper can be used to check lower temperature operations, such as hot roll nips and drying ovens.

If sealing, drying, odor or adhesion troubles develop, the paper is invaluable. The operator can determine immediately if the heat-pressure requirements of the operation are adequate without shutting down the machine for a pyrometer check. He can determine if it is the packaging material or the machine that is at fault. If it is the sealing head that is at fault, the paper can be used to check the effect of the corrective adjustments as they are made. The paper provides a check on the entire seal area while a pyrometer checks only the temperature of the spot where it is placed. Having a pack of paper at each station where it will produce the greatest saving in time and machine waste. To be used most efficiently, it must be readily available.

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Product Development people and trouble shooters can carry the paper with them. Leaving some paper with a customer may save a trouble call by permitting the customer to determine for himself if it is the sealing head or the packaging material that is producing poor seals.

THIS IS TIPI PAPER

(Temperature-Pressure Paper)

This paper will turn a light blue at 200°F. (93°C.) and develop maximum color at 300°F. (149°C.). Place the paper where you wish to measure the seal temperature and pressure. For best results, place the paper between the surfaces being sealed. It is not necessary to break the web; tape the paper to the web passing through the machine. The material being sealed will insulate the TIPI paper from the heat source just as the actual seal is insulated.

To check the back seam seal of a vertical form and fill machine, feed a 2" or 3" wide strip of TIPI paper into the back seam, between the two layers of film, while the machine is running. The same technique may be used to check other back seams, or drag seals, where the sealant on the web is heated and then the web is pressed or clamped together.

To check horizontal vacuum forming machines such as the Multivac, place the TIPI paper, face up, on the formed web. The sheets do not have to be cut to size, they may simply be overlapped on the bottom web. Tack down the leading edge with small pieces of tape and feed the sheets through the machine, allowing the top web to be sealed to the TIPI paper. If the TIPI paper is run through knives, the alignment of the knives and the seals can also be checked.

The paper responds very quickly, 0.1 second or less, depending upon heat and pressure.

If it does not change color:

1. The temperature of the paper is less than 200°F.
2. There is insufficient pressure to transfer the heat from the heat source to the paper.
3. There is insufficient time for the heat to soak through the materials being sealed.

A misaligned, nicked or dirty die will reduce the heat or pressure and this area will show up as a white spot, or a lighter colored area in the seal.

If the material being sealed, seals to the paper so that the color cannot be observed in the heat seal area, fold the paper over on itself and it will break apart at the paper/paper interface.

TIPI paper can be supplied in other sizes and in roll form. A second grade that has temperature range of about 140° to 180°F. (60° to 82°C.) is also available.

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NORMAL MINIMUM HEAT SEAL TEMPERATURE

Low Density Polyethylene	245°F.	118°C.
High Density Polyethylene	285°F.	141°C.
Polypropylene	350°F.	177°C.
Ionomer (Surlyn)	220°F.	104°C.
Ethylene Vinyl Acetate Copolymer (12%)	200°F.	93°C.
Ethylene Vinyl Acetate Copolymer (18%)	170°F.	77°C.

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OTHER FACTORS AFFECTING THE SEALING PROCESS

Temperature Penetration Through Films

The speed at which heat can be transmitted or absorbed by various packaging materials will vary, as does the amount of time it takes to dissipate the heat after sealing. Since the materials are very thin, it takes a very short time to create a seal. A machine running 20 CPM has a dwell time of 1.166 seconds while a machine running 60 CPM has a dwell time of 0.388 seconds. An increase of 10 CPM on the slower machine results in a 43% decrease in dwell time. The temperature settings must be adjusted accordingly. A 10 CPM increase on the faster machine results in a dwell time reduction of 14.3% and a smaller adjustment will need to be made. The operator should realize the change in dwell time when machine speed is adjusted and make the necessary changes in temperature settings. If unsure as to what change needs to be made, run a controlled test.

Extreme Ambient Conditions

Many conditions affect the packaging machine's performance. Excessive air currents around the seal bars and thermocouples can cause inaccurate temperature readings. Water around the machine increases the risk of electrical short circuits and shock. It will completely distort temperature readings if allowed in the seal bar area. Keep areas around the machine clean, dry and shrouded from air currents (if necessary).

Fine Tuning the Machine

Fine tuning the machine is nothing more than making sure every part of the machine is properly adjusted. Situations, like when the pull wheels close late, cause undue wear and may lead to foil fracture, large seal wrinkles and even leakers. Check all parts of the machine; the pull wheels, the tracking rolls, the seal bars, etc. If something isn't working or is out of adjustment, fix it.

QUALITY ASSURANCE CHECKS THAT CAN BE RUN TO HELP INSURE PACKAGE INTEGRITY

1. A 12 package sample collector can be built to help the operator or the QA person to collect one set of 12 packages from across the machine width at one time.

2. The collection and subsequent inspection of a full set of packages can reveal any abnormality across the machine width (e.g., side seal width, pillowing, misalignment, etc.). This inspection may reveal gross problems with the portion control (e.g., ketchup) packages.

3. Inspection tests and the problems they may reveal:

   a. Squeeze test - Take the package between your thumb and index finger and squeeze it into a waste basket. This test will reveal weak side or end seals as they will break open when this pressure is applied. A good package will hold up to this test.

   b. Side seal width and location - Look at the width of the side seals as well as the location of these seals on the package. The side seals should be at least 1/16" wide and should be about the same width on each side. The seals should not intrude into the printed area. If this starts happening, the fill tubes may be out of alignment or the film is being skewed or twisted in the machine due to pull roll problems.

   c. End seals - Look at the end seals and check for large foldover wrinkles. Foldovers happen in almost every package, but they should remain small or they may result in gross leakers or serum leakers. You will want to see at least two seal ribs in each end seal to help seal off potential serum leakers and to impart seal strength.

   d. Package length - The length of each package should be consistent and this can be evaluated by looking at where the end seals are falling. They should fall outside the printed area and they should be of equal width at each end. The fill level in each package should only take up about three quarters of the package. If filled above this level, product (e.g., ketchup) may start to contaminate the end seal area causing leakers.

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e. Always look for trends when inspecting the packages. Problems may be relegated to outside lanes or inside lanes or to a particular machine. By noting where the problems are arising, you may be able to diagnose what the cause may be.

f. Quality Assurance people along with Production Supervisors need to have the ability to inspect packages and determine if a problem exists. They should work in concert with the machine operator to diagnose and take corrective action when a problem arises.

SERUM LEAKERS

1. What is a serum leaker?

   It is the flow of serum through a channel formed between the sealant layers during the fabrication of a PC ketchup pouch on a multi-lane packaging machine. Serum leakers do not occur on a properly set-up and maintained packaging line. Also refer to Chapter 8 (page 71) for additional information on leakers.

2. What is serum?

   It is a component of the product that has very low viscosity which allows for it to penetrate and flow through very small channels in the seal areas of a product's package.

3. What causes the channel through which the serum leaks?

   The channel is caused when the sealant in a small area of the cross seal is not fused. This lack of fusion may be the result of a wrinkle in a cross seal, which is caused by the gathering that takes place when flat film is formed into a cylindrical package and then flattened during the sealing process.

4. Why isn't the channel sealed off during the sealing process?

   The wrinkle causes a situation where insufficient heat and/or pressure is applied in that area due to the insulating effects of the extra layers of film present in the wrinkle. A wrinkle forms in almost every package so many of the channels are sealed off, but it only takes a few serum leakers to make a mess of a case of product.

5. How big does the channel need to be to allow a leaker?

   The channel can be a small as one mil (0.001") in diameter for it to cause a leaker. The more likely size, however, is in the three to four mil range.

6. Where are most serum leakers found?

   It has been noted that 95+% of serum leakers are found in the cross seal and about 70% are in the top cross seal. Also, 60% are found in the outside two lanes of the pouch machine. This again indicates that the gathering of the film and subsequent wrinkles may be the cause of most serum leakers.

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7. Can serum leakers be prevented?

   They can be prevented and this is indicated by the fact that almost every PC pouch has a wrinkle in the end seal, but every pouch does not leak. The packaging machine must be maintained very diligently, as it doesn't take much to initiate serum leakers. Packaging of the PC pouches may also impact package integrity. Pressure applied to these pouches will help provide the impetus for the serum to be pushed out through the channel. The more pressure that is applied, the smaller the channel needed to result in a leaker. Overpacking cases and then stacking the cases too high on pallets can cause undue pressure to be applied and this may exaggerate the serum leaker rate.

8. Can serum leakers be alleviated by correct choice of packaging materials?

   Packaging films have changed drastically over the last twenty years, yet serum leakers were there then and they are still here now. Studies have been done varying sealant materials and sealant thicknesses along with packaging machine conditions. These studies indicate that the packaging materials of today have no impact on the serum leaker rate and that has been the case for the last ten years.

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Curwood Inc.

SERUM LEAKER DETECTION

Serum leakers will take place through wrinkles or channels in the end seals (especially the top seal) after a period of time. Pressure on the packages can worsen this type of leaker. The tests below are methods designed to help diagnose a serum leaker problem.

1. Collect three sets of 12 packages to be used in an off line check for serum leakers. The test is run as follows:

   a. Place one set of 12 packages (3 across by 4 down) on some absorbent towel and then cover with another layer of toweling.

   b. Next, place a rigid flat tile or board on top of this toweling and then cover the top of the tile with another layer of towels. Place the next set of packages on this layer of towels and cover with towels.

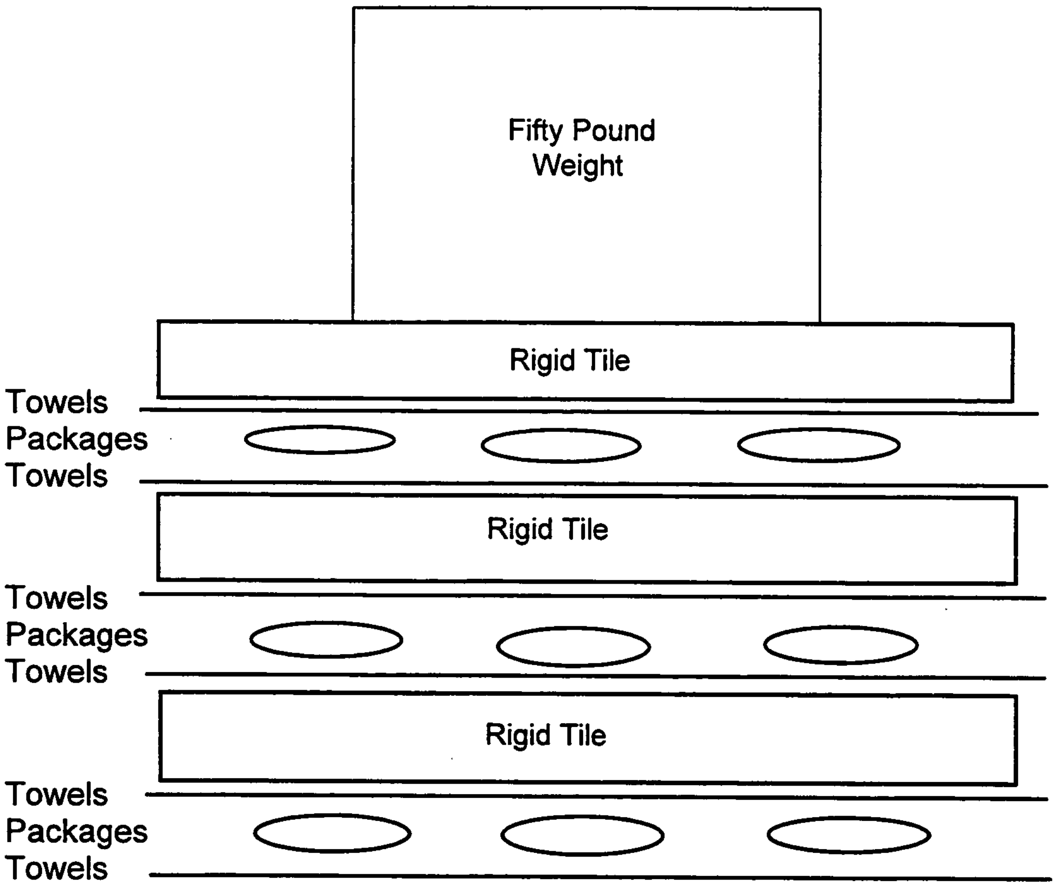
   c. Repeat step B with one more layer of packages and towels and put the last rigid tile on top.

   d. Place a 50 pound weight on top of the last rigid tile.

   e. Check the packages at two to three hour intervals to determine if serum leakers are being generated. This test will tend to show a bad serum leaker tendency within a couple of hours. A smaller problem will be seen in 24 hours. While not an immediate check for serum leakers, it can be used to show tendencies and can reveal the location of problem areas.

SERUM LEAKER TEST

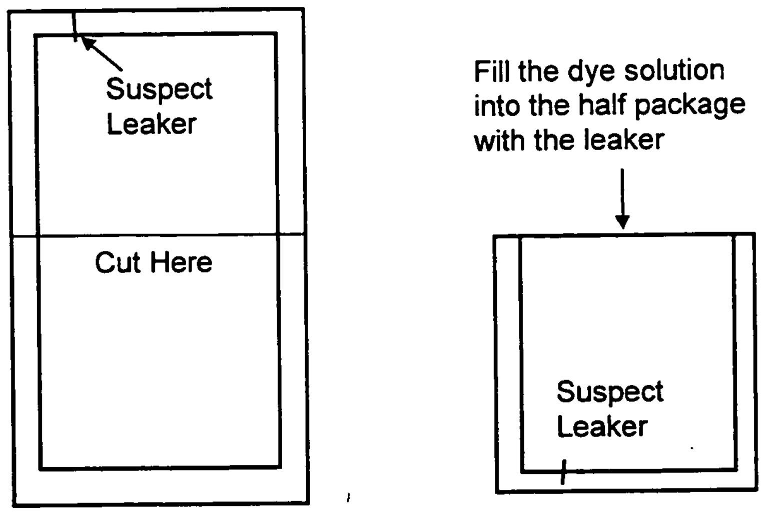
EQUIPMENT AND PACKAGE SET-UP



METHYLENE BLUE PENETRATING DYE TEST

1. Choose packages off line that are suspected as serum leakers. They may be identified by a previous test like the 50 lb. weight test or they may show large end seal wrinkles.

2. Cut the package in half in a manner such that you have the suspected leaker location at the bottom seal in the half package.



3. Fill the methylene blue dye into this half package and hold over a white towel.

4. The dye should penetrate through the leaker channel within 5 minutes revealing a potential site for a serum leaker.

<u>Recipe for Dye</u>
25% Isopropyl Alcohol
75% Distilled Water
Victoria Blue B Dye Powder

Add enough powder to tint the alcohol/water mixture a deep blue.

Guidelines for Portion Control Packages
Curwood Inc.

POUCH MACHINE TRAINING CHECKLIST

This machine must only be operated by Qualified Personnel. Qualified Personnel must be familiar with the following checklist of adjustments and safety procedures.

Winpak Lane, Inc. Service Representatives are available and should be present during initial startup and subsequent changes in personnel to explain these checklists in detail. It is important to have "hands on" practice while under this supervision. Refresher courses are recommended on at least an annual basis.

The following lists are in two categories. The first list titled "Operator's" is important for all Qualified Personnel to understand. The second list titled "Technician's" is for the Qualified Personnel who will be responsible for tuning and maintaining the machine.

POUCH MACHINE OPERATOR'S CHECKLIST

Company Name ____
Machine Serial Number ____________________________________
Customer Service Representative ____________________________
Customer's Qualified Person ________________________________

SAFETY CHECKLIST

The customer is responsible for developing their own safety and operational procedures. The following information is offered as a guideline.

_____ 1. Machinery is to be operated by qualified personnel only.

_____ 2. DO NOT operate this machine unless all safety systems are in place.

_____ 3. Verify machine is "clear" of people working around the machine as well as tools, loose parts, etc. DO NOT lay anything on the machine because it may vibrate off and into the product or onto you! Razor blades used for cutting film are especially hazardous.

_____ 4. Use extra care around knives, blades, sealing dies and moving parts.

_____ 5. When lifting or moving materials, use proper procedures, equipment and assistance as needed.

_____ 6. DO NOT wear loose clothing or jewelry around this equipment.

_____ 7. Keep work area clean and free from scrap, trash, cords, etc.

_____ 8. Report unsafe conditions to your supervisor immediately.

_____ 9. DO NOT leave machine unattended while in operation.

_____ 10. Clean up spills immediately. DO NOT attempt to clean this machine while in operation.

_____ 11. Watch for overhead obstructions such as pouch machine film frames.

_____ 12. Never operate this machine alone. Always have someone nearby who understands where the emergency stop is, and is capable of using it.

_____ 13. <u>DO NOT</u> operate this machine with wet hands, electrical shock may result.

_____ 14. Check with supervisor if in doubt about safety related procedures.

_____ 15. Follow your Company's lockout/tagout policy. This machine can have potential (stored) energy even after locking out energy sources. These can be handled as follows:

TYPE	HOW STORED	ACTION
Electrical	Capacitors Static in packaging materials	Discharge Discharge
Pneumatic	Pressurized air	Relieve with emergency shut off valve
Heat	Sealing systems	Allow to air cool or use gloves
Heat (or cold)	Product delivery and pumping systems and packaged product	Allow air to cool (or warm) or use gloves
Spring	Extension springs	Release or secure in place

OPERATIONAL CHECKLIST

The customer is responsible for developing their own safety and operational procedures. The following information is offered as a guideline.

_____ 1. Check safety systems before starting
   - a. Guards securely in place
   - b. Air and power shut offs accessible and not tagged or locked out
   - c. Air and power lockouts accessible and operational
   - d. Film rolls securely in cradles
   - e. Auxiliary conveyors and product delivery shut offs operable

_____ 2. Controls and related functions
   - a. Electrical disconnect
   - b. Side seal switch
     - 1) temperature controls
   - c. Cross seal switch
     - 1) temperature controls
   - d. Counter switch and counters
     - 1) counter reset switch
   - e. Eye switch
   - f. Drive motor switch
   - g. Pull wheel switch
   - h. Seal bar switch
   - i. Pump rotor switch
   - j. Knife switch
   - k. Film alignment and tension adjustments
   - l. Speed control
   - m. Knife adjustment
   - n. Fill tube adjustments

_____ 3. Setting up film
   - a. Roll change
   - b. Splicing

_____ 4. Package quality
   - a. Fill weights
   - b. Seal integrity
   - c. Overall appearance

POUCH MACHINE TECHNICIAN'S CHECKLIST

Company Name ________________________________

Machine Serial Number ________________________________

Customer Service Representative ________________________________

Customer's Qualified Person ________________________________

Prior to understanding the following items, a thorough command of the "Machine Operator's Checklist" must be accomplished.

SAFETY CHECKLIST

The customer is responsible for developing their own safety and operational procedures. The following information is offered as a guideline.

_____ 1. DO NOT modify or defeat any safety related devices.
- a. Guards securely in place
- b. Interlocks operational
- c. Electrical and air safeties operational
- d. Guard bypass in the off position

_____ 2. DO NOT operate a machine that is in an unsafe condition.

_____ 3. DO NOT work on a machine that has not been well grounded.

_____ 4. DO NOT stand on this machine. Use ladders and hoists when needed.

_____ 5. Use gloves for handling hot parts such as seal bars.

_____ 6. Presume moveable parts will move. Plan ahead so that you can get out of the way (seal bars, cut-off knives, gears, chains, linkages).

_____ 7. Survey condition of equipment before use, know its limitations and do not force it.

_____ 8. Presume wrenches and pry bars will slip off your work, plan ahead so that when this happens, your hands and arms will not get injured.

_____ 9. Never put power to a machine that is being worked on, lock power and air out. Appoint one person to cycle machine when needed (this person is responsible to watch for potential hazards). Never turn a machine on unless someone is in the immediate area with you who understands where the emergency stops are.

_____ 10. DO NOT run a machine that has a red tag on it.

_____ 11. Presume that hand drills will bind and try to throw you off balance, plan ahead.

_____ 12. Double-check component electrical wiring with a voltmeter before touching. DO NOT wear conductive materials on hands or arms.

_____ 13. Wear closed-toe leather shoes.

ADJUSTMENTS CHECKLIST

1. Machine timing and adjustments
    a. Bag length adjustment
    b. Knife adjustment
    c. Eye registration adjustments
    d. Side seal pressure
    e. Cross seal pressure
    f. Package fill weights
    g. Air pressure adjustments
    h. Pull roller adjustments
    i. Filler adjustments
        1) Pistons, floating, rotor timing
    j. Sequence programmer or PLC
        1) Encoders and adjustments
        2) Programming
    k. Seat heat calibration and setting
    l. Fill tune alignment

MAINTENANCE CHECKLIST - FREQUENT

_____ 1. Lubricate, check oiler
_____ 2. Teflon tape seal bars and fill tubes
_____ 3. Check razor blades and knives

MAINTENANCE CHECKLIST - OCCASIONALLY

_____ 1. Check pump rotor and rotor body for wear, replace "O" rings and lubricate
_____ 2. Check pump pistons and piston body for wear, replace "O" rings
_____ 3. Check pump gaskets
_____ 4. Replace crimped or weak hoses from pump to fill tubes
_____ 5. Check seal bar linkage and make sure it "overlocks"
_____ 6. Drain water tap

MAINTENANCE CHECKLIST - PREVENTATIVE MAINTENANCE

_____ 1. Replace worn:
  a. rod ends
  b. gear racks
  c. gears
  d. overlocks
  e. cam followers
  f. fill weight adjuster parts
  g. bushings
  h. bearings
  i. air lines

_____ 2. Check motor mounts for vibration
_____ 3. Check air valves for leaks
_____ 4. Replace air muffler
_____ 5. Check air cylinders for wear, leaks and cushions
_____ 6. Check covers on electrical components for seals
_____ 7. Check for loose or exposed wires
_____ 8. Replace seal bar die springs in sets
_____ 9. Replace heat cartridges in sets
_____ 10. Replace thermocouples in sets

DRAFT
L12 & L18 POUCH MACHINE OPERATING PARAMETERS
1/20/97

This form should be completed by the machine builder prior to commissioning.

	PRIMARY PUMPING SYSTEM		SECONDARY PUMPING SYSTEM		TERTIARY PUMPING SYSTEM	
	HIGH	LOW	HIGH	LOW	HIGH	LOW
Product viscosity range						
Product temperature range (F.)						
Volume range (gms)						
Target cycles per minute						
Room temperature range (F.)						
Room humidity range (F.)						
Packaging material limitations:						
Product limitations	Non-foaming, consistent density and pressures					
Sanitation limitations						
Operator qualifications	See Pouch Machine Operators Checklist					
Min/max air volume (SCFM)	80					
Min/max power (volts/phase/cycles)						

DRAFT
L12 & L18 POUCH MACHINE
STARTUP CHECKLIST
1/20/97

The customer is responsible for developing their own safety and operational procedures. The following information is offered as a guideline.

Operation of this machine must be by qualified Personnel only. (See separate Pouch Machine Operators Checklist).

1. Pump system installed and all product piping connections air tight.
2. Sanitation complete.
3. Packaging material tension system in place.
4. Seal bars taped.
5. Razor blades in place.
6. Code dates correct.
7. Tools and knives off of machine.
8. Film properly loaded and threaded.
9. All lockouts properly removed.
10. Guards in place and closed.
11. Switch electrical disconnect on.
12. Air emergency shut off valve fully on.
13. People clear of danger.
14. Pull Machine Emergency Stop switch out. Switch on; seal bar heaters, registration eye, counter (optional), splice detector. Switch guard bypass off.
15. Seal temperature within range.
16. Switch drive mode to run, push drive button, switch on; seal bars and pull wheels.
17. Dancer bars not bottoming out.
18. Overlocking properly.
19. Slitting vertically properly.
20. Conveyor/packoff ready and on.
21. Product supply ready.
22. Product supply valve(s) open.
23. Switch on; pump rotor and knives.
24. Cutting properly, horizontal.
25. Push counter reset switch (optional).
26. Check seal integrity.
27. Check fill weights.

ANALYSIS OF THE COSTS ASSOCIATED WITH POUCH PACKAGING MACHINE WASTE

This tool shows how the finished product costs increase as the percentage of waste increases. You may change all of the numbers in Assumptions to meet your specific situation.

		Assumptions:
1.	Pouch machine speed in cycles per minute	85
2.	Packages per cycle per pouch machine	12
3.	"Standard" production minutes per shift	400
4.	Labor + overhead costs per shift per machine	$520.00
5.	Packaging material price per 1,000 packages	$2.80
6.	Product cost per 1,000 packages	$7.80
7.	Percentage waste, best case number	5%
8.	Ratio of product waste inside packaging waste (for example, 50% means that 50% of the wasted packaging material would also have product in it)	50%

Waste Factor Percentages	Waste Costs by Components			Total Waste Costs	
	Wasted Packaging Material Costs per 1,000 Packages Sold	Wasted Product Costs per 1,000 Packages Sold	Wasted Labor + Overhead Costs per 1,000 Packages Sold	Total Waste Costs per 1,000 Packages Sold	Total Waste Costs per Shift
5%	$0.1474	$0.2053	$0.0671	$0.4197	$162.68
6%	$0.1787	$0.2489	$0.0814	$0.5090	$195.22
7%	$0.2108	$0.2935	$0.0959	$0.6002	$227.75
8%	$0.2435	$0.3391	$0.1108	$0.6934	$260.29
9%	$0.2769	$0.3857	$0.1261	$0.7887	$292.82
10%	$0.3111	$0.4333	$0.1416	$0.8861	$325.36

This tool is available on computer disk from Winpak Lane.
Original concept created by Bob Kraatz.

CUP MACHINE TRAINING CHECKLIST

This machine must only be operated by Qualified Personnel. Qualified Personnel must be familiar with the following checklist of adjustments and safety procedures.

Winpak Lane, Inc. Service Representatives are available and should be present during initial startup and subsequent changes in personnel to explain these checklists in detail. It is important to have "hands on" practice while under this supervision. Refresher courses are recommended on at least an annual basis.

The following lists are in two categories. The first list titled "Operators" is important for <u>all</u> Qualified Personnel to understand. The second list titled "Technicians" is for the Qualified Personnel who will be responsible for tuning and maintaining the machine.

CUP MACHINE OPERATOR'S CHECKLIST

Company Name ______________________________
Machine Serial Number ______________________________
Customer Service Representative ______________________________
Customer's Qualified Person ______________________________

SAFETY CHECKLIST

The customer is responsible for developing their own safety and operational procedures. The following information is offered as a guideline.

_____ 1. Machinery is to be operated by qualified personnel only.

_____ 2. DO NOT operate this machine unless all safety systems are in place.

_____ 3. Verify machine is "clear" of people working around the machine as well as tools, loose parts, etc. DO NOT lay anything on the machine because it may vibrate off and into the product or onto you! Razor blades used for cutting film are especially hazardous.

_____ 4. Use extra care around knives, blades, sealing dies and moving parts.

_____ 5. When lifting or moving materials, use proper procedures, equipment and assistance as needed.

_____ 6. DO NOT wear loose clothing or jewelry around this equipment.

_____ 7. Keep work area clean and free from scrap, trash, cords, etc.

_____ 8. Report unsafe conditions to your supervisor immediately.

_____ 9. DO NOT leave machine unattended while in operation.

_____ 10. Clean up spills immediately. DO NOT attempt to clean this machine while in operation.

_____ 11. Watch for overhead obstructions such as machine film frame.

_____ 12. Never operate this machine alone. Always have someone nearby who understands where the emergency stop is, and is capable of using it.

_____ 13. DO NOT operate this machine with wet hands, electrical shock may result.

_____ 14. Check with supervisor if in doubt about safety related procedures.

_____ 15. Follow your Company's lockout/tagout policy. This machine can have potential (stored) energy even after locking out energy sources. These can be handed as follows:

TYPE	HOW STORED	ACTION
Electrical	Capacitors Static in packaging materials	Discharge Discharge
Pneumatic	Pressurized air	Relieve with emergency shut off valve
Heat	Sealing systems	Allow to air cool or use gloves
Heat (or cold)	Product delivery and pumping systems and packaged product	Allow air to cool (or warm) or use gloves
Spring	Extension springs	Release or secure in place

OPERATIONAL CHECKLIST

The customer is responsible for developing their own safety and operational procedures. The following information is offered as a guideline.

_____ 1. Check safety systems before starting
   a. Guards securely in place
   b. Air and power shut offs accessible and not tagged or locked out
   c. Air and power lockouts accessible and operational
   d. Lidding stock securely in cradle
   e. Auxiliary conveyors and product delivery shut offs operable

_____ 2. Controls and related functions
   a. Electrical disconnect
   b. Head seal switch
   c. Power reset
   d. Vacuum
   e. Scanner
   f. Drive motor switch
   g. Pump rotor switch
   h. Knife switch
   i. Film feed
   j. Cup sensor
   k. Emergency stop
   l. Head seal adjustments
   m. Knife adjustment
   n. Film alignment and tension adjustments

_____ 3. Setting up film
   a. Roll change
   b. Splicing

_____ 4. Cup quality
   a. Fill weights
   b. Seal integrity
   c. Overall appearance

CUP MACHINE TECHNICIAN'S CHECKLIST

Company Name ______________________________
Machine Serial Number ______________________________
Customer Service Representative ______________________________
Customer's Qualified Person ______________________________

Prior to understanding the following items, a thorough command of the "Machine Operator's Checklist" must be accomplished.

SAFETY CHECKLIST

The customer is responsible for developing their own safety and operational procedures. The following information is offered as a guideline.

_____ 1. DO NOT modify or defeat any safety related devices.
   a. Guards securely in place
   b. Interlocks operational
   c. Electrical and air safeties operational

_____ 2. DO NOT operate a machine that is in an unsafe condition.

_____ 3. DO NOT work on a machine that has not been well grounded.

_____ 4. DO NOT stand on this machine. Use ladders and hoists when needed.

_____ 5. Use gloves for handling hot parts such as the head seal.

_____ 6. Presume moveable parts will move. Plan ahead so that you can get out of the way (head seal, knife, gears, chains, linkages).

_____ 7. Survey condition of equipment before use, know its limitations and do not force it.

_____ 8. Presume wrenches and pry bars will slip off your work, plan ahead so that when this happens, your hands and arms will not get injured.

_____ 9. Never put power to a machine that is being worked on, lock power and air out. Appoint one person to cycle machine when needed (this person is responsible to watch for potential hazards). Never turn a machine on unless someone is in the immediate area with you who understands where the emergency stops are.

_____ 10. DO NOT run a machine that has a red tag on it.

_____ 11. Presume that hand drills will bind and try to throw you off balance, plan ahead.

_____ 12. Double-check component electrical wiring with a voltmeter before touching. DO NOT wear conductive materials on hands or arms.

_____ 13. Wear closed-toe leather shoes.

ADJUSTMENTS CHECKLIST

1. Machine timing and adjustments
    a. Drive motor
        1) Increase or decrease machine speed
    b. Lidding stock drive
        1) Loading film
        2) Centering film to cups
        3) Increase or decrease speed
        4) Timing cam
        5) Prox. sensor
    c. Denester "Thiele"
        1) Loading cups
        2) Air cylinder cam timing
        3) Placing cups to brass screw
        4) Vacuum and air
        5) Cup sensor and timing cam
    d. Denester "Lane"
        1) Loading cups
        2) Timing screws
        3) Placing cups to brass screw
        4) Disengaging denester
        5) Cup sensor and timing cam
    e. Filler adjustments
        1) Pistons, floating
        2) Rotor cam timing
        3) Piston height

MAINTENANCE CHECKLIST - FREQUENT

_____ 1. Lubricate, check oiler
_____ 2. Check head seal pad
_____ 3. Check razor blades and knives

MAINTENANCE CHECKLIST - OCCASIONALLY

_____ 1. Check pump rotor and rotor body for wear, replace "O" rings and lubricate
_____ 2. Check pump pistons and piston body for wear, replace "O" rings
_____ 3. Check pump gaskets
_____ 4. Drain water trap

MAINTENANCE CHECKLIST - PREVENTATIVE MAINTENANCE

_____ 1. Replace worn:
  a. rod ends
  b. chains
  c. sprockets
  d. carrier plates
  e. cam followers
  f. fill weight adjuster parts
  g. bushings
  h. bearings
  i. air lines
_____ 2. Check motor mounts for vibration
_____ 3. Check air valves for leaks
_____ 4. Replace air muffler
_____ 5. Check air cylinders for wear, leaks and cushions
_____ 6. Check covers on electrical components for seals
_____ 7. Check for loose or exposed wires
_____ 8. Replace head seal die springs in sets
_____ 9. Replace heat cartridges in sets
_____ 10. Replace thermocouples in sets